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AMERICAN
DYESTUFF REPORTER
DEVOTED TO THE INTERESTS OF TEXTILE CHEMISTRY
BLEACHING ◆ DYEING ◆ FINISHING ◆ PRINTING

VOLUME 26 APRIL 19, 1937 NUMBER 8

A Message

to the knitter . . .

For over three quarters of a Century, the Geigy organization has devoted itself to the dyestuff needs of the Knitter and the requirements of his consumer.

Devotion to those needs and requirements meant living with the problems that were those of your industry—problems which today's art takes lightly.

Through this era the experiences which you acquired were those the Geigy scientists and colorists absorbed.

And when the synthetic fibres presented their new problems, those same scientists and colorists quickly were prepared, not only with the solution, but had gone on to show the way to enhance the Knitter's product with effects on multi-fibres which gave new life, new style and increased saleability to the product.

The confidences of those close associations have been appreciated, since through those associations Geigy has gathered that experience which has simplified your color problem and mine.

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OFFICIAL PUBLICATION OF THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

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DEVOTED TO THE INTERESTS OF TEXTILE CHEMISTRY
• BLEACHING • DYEING • FINISHING • PRINTING •
AND THE NECESSARY MECHANICAL EQUIPMENT

"Circulated Everywhere Textiles Are Processed"

Subscription Price: $5.00 per year; Canadian, $6.80; Foreign, $6.00. Fifty cents per copy

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Official Publication of the American Association of Textile Chemists and Colorists

THE OBJECTS OF THIS ASSOCIATION ARE:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable ways research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

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AMERICAN
DYESTUFF REPORTER

VOLUME 26 APRIL 19, 1937 NUMBER 8

Thirty-Third Annual Knitting Arts Exhibition

TODAY marks the opening of the thirty-third Annual Knitting Arts Exhibition at the Commercial Museum in Philadelphia which is being held under the auspices of the National Association of Hosiery Manufacturers and the Underwear Institute. The exhibition continues through Friday of this week. This represents an excellent opportunity for buyers and sellers to meet together under ideal conditions where comparisons can easily be made. The latest developments in equipment and methods are brought together under one roof where a leisurely examination is possible.

The industry's leading manufacturers of knitting, dyeing and drying machinery, mill supplies and allied products, are now exhibiting their latest designs, processes and mechanical features. These manufacturers consider it to be one of the most economical and effective means of demonstrating their products to the entire knitting trade in one place at one time. They show that they know this to be true by the fact that they exhibit year after year . . . figures indicate that 93 per cent of the exhibitors repeat year after year.

Those who are engaged in the wet processing branch of the knit goods and hosiery industry can see many exhibits which will prove of special interest to them. We suggest that you see all of the exhibits if possible but if you are in a hurry and wish to save time we believe that the following descriptions will prove of value to you in order that you may see the latest developments in the particular branch of the industry in which you have the greatest interest.

AMERICAN ANILINE & EXTRACT COMPANY, INC.

Venango and F Streets, Philadelphia, Pa.

Space 176

This booth is being used for reception purposes where everyone will be made welcome. They are not going to show any products or solicit any business except on Orthopol A Concentrate as they feel the savings should be brought to the attention of the entire hosiery industry.

In attendance: A. B. McCarty, T. P. Key, F. A. Carsten, and W. P. Gudgeon (Canadian Aniline & Extract Co., Ltd., Hamilton, Ont.)

H. W. BUTTERWORTH & SONS, COMPANY, INC.

York and Cedar Street, Philadelphia, Pa.

Spaces 58, 59 and 60

In conjunction with the Tubular Textile Machinery Corp., New York, N. Y., Butterworth is showing the Tube-Tex Wet Spreading, Extracting and Processing Machine in actual operation.

In attendance: for Butterworth:—Harry W. Butterworth, Jr., DeHaven Butterworth and W. E. H. Bell; for Tubular:—Mortimer Cohn and Jules Walters.

W. F. FANCOURT & CO., INC.

516-518 South Delaware Avenue, Philadelphia, Pa.

Space 212

This space features Aquapel A F, a one-bath waterproofing and finishing material and Aquapel, a splashproof hosiery finish said to be of great stability which imparts snag and crease-proofing properties. Several new products will be shown including Fanco Finishing and Weighting Oil D 138 which is said to withstand the severest treatment without developing any odor or rancidity, and other specialties of interest to the knitting trade.

In attendance: W. F. Fancourt, Jr., W. F. Fancourt, 3rd, and Charles T. Harvey.

FLETCHER WORKS, INC.
Glenwood Avenue and Second Street, Philadelphia, Pa.
Spaces 144, 145, 146 and 147

Extractors and throwing machinery are exhibited. A new extractor, the Fletcher "Standard," will be shown for the first time. This machine, in a lower price class than the deluxe Fletcher "Junior" extractor, is said to have such quality features as ball bearings, V-belt drive, spun-smooth basket, and interlocking cover to comply with all safety laws.

In attendance: R. J. Batholomew, W. H. Rometsch, Charles W. Moore and Harry N. Rahn.

THE J. B. FORD COMPANY
Wyandotte, Michigan
Space 307

The following Wyandotte products are featured at this booth: textile soda, Huron alkali, Wool Scouring Special, concentrated ash, Textile White Ash, K B Special, K B X, Steri-Chlor.

In attendance: F. S. Klebart, James F. Flaherty, H. E. Moyer and John W. Turner.

GRAND RAPIDS TEXTILE MACHINERY CO., INC.
1405 S. Division Avenue, Grand Rapids, Mich.
Space 133 AA

This exhibit consists of machinery in operation for the dyeing, finishing, cutting, and pressing departments. The following machines are exhibited: sample piece dyeing machine (metal), extractor loader and unloader, swatch drier and steamer, new steaming, spreading and rolling machine, universal calendar and folder for tubular goods, hand cutting table for tuck stitch underwear fabric and a roto press for pressing athletic shirts, underwear and sweaters.

In attendance: W. H. Shields, W. F. Moon and an assistant.

HUNGERFORD & TERRY, INC.
Clayton, New Jersey
Space 140

On exhibition here is the Inversand water softener machine with gravel retaining screen and Hardimeter, samples of various equipment and zeolites, photographs, literature, etc.

In attendance: D. M. Hungerford, F. C. Myers, C. Hungerford, Jr., S. F. Alling and G. Lang.

HYGROLIT, INC.
Kearny, N. J.
Space 57

Exhibited here is the Hygrolit Yarn Conditioning Machine Model BDE/F2 for the conditioning of yarns on cones or packages.

In attendance: C. F. Dulken, H. E. Kresse and J. Winzkurk.

THE INDUSTRIAL DRYER CORPORATION
Box 850, Stamford, Conn.
Spaces 11 and 12

This exhibit consists of the latest model "H-W" Conditioner and Twist Setter. The conditioner is equipped with a 12-inch temperature and humidity controller and recorder, electric time clock and all instruments for its complete automatic operation.

In attendance: Charles M. Kitzmiller and George D. Millspaugh.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.
Spaces 13 and 14

This display features mill and fabricated forms of Monel dyehouse equipment. Included in this display are Monel textile dry cans, dye beam, spindles and perforated tube for package dyeing, piece goods dyeing equipment, starch cookers, dye tank linings, dye sticks, utensils and accessories.

In attendance: E. A. Turner, C. J. Bianowicz and members of the technical service staff.

W. H. & F. JORDAN, JR., MFG. COMPANY
3047-49 Amber Street, Philadelphia, Pa.
Spaces 20 and 20 AA

The following products are on display: textile oils, cotton softeners, sulfonated oils, penetrating agents, scouring oils, and specialties.

In attendance: Canfield Jordan, H. B. Dohner, R. A. Bruce, Jack McGrogan, G. C. Harkins and F. T. Quinlan.

LAUREL SOAP MFG. COMPANY, INC.
Tioga, Thompson and Almond Sts., Philadelphia, Pa.
Space 178

Samples of fabrics which have been treated with Laurel soaps, oils and finishes are on display here.

In attendance: C. E. Bertolet, William H. Bertolet, Jr., A. Henry Gaede, E. W. Seasongood and C. C. Hagelgans.

LEATEX CHEMICAL CO.
2722 North Hancock St., Philadelphia, Pa.
Space 37

No products are displayed but the booth is maintained as a headquarters for Leatex salesmen and for the convenience of visiting friends and clients.

In attendance: John McChesney, John F. Rieder, Maurice Guertin, Charles L. Hammell, H. Higginbotham, Louis Soistmann, Robert R. Willgoos.

ONYX OIL & CHEMICAL CO.
Jersey City, N. J.
Space 184

Featured at this booth is a new development, Silk-O-Ray, for silk hosiery and rayons. It is said to impart an

unusually soft, full, lofty hand and appearance to hosiery. On rayons it is said to produce a realistic, soft, silky effect; to impart a permanent scroop; to elongate the fibers without loss of strength; to give full body and richness; to lay the fuzz. A partial delustering effect is also said to be obtained. Other products shown are samples of degumming, dyeing, dulling, spotproofing and finishing compounds, together with samples of hosiery and underwear processed with Onyx compounds.

In attendance: C. D. EHRENGART, LEON P. BRICK, J. W. HUBER, E. A. BRICK, J. E. TRESIZE, E. W. KLUMPH.

PERMUTIT COMPANY

330 West 42nd Street, New York, N. Y.

Space 310

On exhibition is the new portable Ranarex Mechanical CO_2 Indicator, Zeolite, processed and synthetic, and Permutit single multi-port valves for water softeners and filters both manually and automatically operated.

In attendance: M. F. CORIN, D. J. HESS and W. L. LOWRIE.

THE PHILADELPHIA DRYING MACHINERY CO., INC.

3351 Stokley Street, Philadelphia, Pa.

Space 175

This exhibit consists of illustrations of latest improved drying machinery for raw stock, skein and warp yarns, hosiery, underwear, towelling and piece goods as well as tenter dryers, carbonizing equipment and vacuum extractors.

In attendance: W. W. SIBSON, C. H. REUMANN, H. O. KAUFMANN and B. M. JONES.

PHILADELPHIA METAL DRYING FORM CO.

Hunting Park Avenue at 16th Street, Philadelphia, Pa.

Spaces 168 and 185

Hosiery drying form equipment is exhibited here. Specially featured are special attachments for changing shapes of drying forms and tissue and Cellophane inserters for hosiery.

In attendance: PAUL GUGGENHEIM, JOSEPH SELIGMAN and ERNEST WOLFF.

PROCTOR & SCHWARTZ, INC.

Seventh Street at Tabor Road, Philadelphia, Pa.

Spaces 232, 233, 242, 243, 252 and 253

A working demonstration is given of two types of boarding machines, one for women's hosiery and one for men's half-hose. Special attention is given to an automatic device for imparting a special finish to long, short or medium length hosiery, after it leaves the hands of the boarders. A new hard finish to the hosiery boards is also shown and a modern method of obtaining equalized drying of sheer or other weight stockings is demonstrated.

In attendance: C. T. GRIFFITH, CHAS. S. TIERS, HARRY B. LEX, WM. J. MERRIGAN.

QUAKER CHEMICAL PRODUCTS CORP.

Conshohocken, Pa.

Space 376

On display at this booth is a wide variety of special chemicals and oils for every textile process, for example: boil-off oils, needle oils, stainless oils, delustrants, detergents, softeners, penetrants, kier assistants, weighters, silk oils, etc.

In attendance: R. K. GURNEY, JOHN ZURN, GEORGE LOBB, HARRY N. KOPPLE, JOHN W. BROWN, DR. ADOLPH KRUEGER and E. NIESSEN.

REPUBLIC STEEL CORPORATION

Cleveland, Ohio

Spaces 40, 41, 42 and 43

This exhibit features Enduro Stainless Steel and products manufactured from this steel such as an experimental bleaching kier, expander arrangement, tenter frame clip, roller bearings, miniature dry can and liner, miniature jig tub, dye jig, humidifying unit, pails, dippers, utensils and other fabricated articles.

In attendance: C. C. SNYDER, G. W. HINKLE, L. L. CASKEY, E. S. DEHN, E. C. ANDERSON, J. K. BOLE, W. H. OLIVER, H. N. EVANS and A. W. MINUSE.

ROCHESTER ENGINEERING & CENTRIFUGAL CORPORATION

110 Buffalo Road, Rochester, N. Y.

Spaces 213 and 214

The equipment shown here includes a 48-inch O.T. Extractor, a 17-inch Monex Extractor, a 30x36-inch 50-lb. Super Dyeing Machine, and a 30x20-inch 25-lb. Super Dyeing Machine. New features of the Super Dyeing Machines are said to include the following: Monel metal construction, both cylinder and tub; all cylinder perforations are hand finished and doubly embossed; baffle plates are fastened on the inside of the tub to control the flow of the dye liquor; complete conveniences added; large liquor ratio of 21 to 1; where desired, machines can be made of stainless steel.

In attendance: R. C. CAINE, P. B. COMPTON and C. F. FISCHER.

SCHOLLER BROTHERS, INC.

Collins and Westmoreland Streets, Philadelphia, Pa.

Spaces 215 and 216

Shown here are samples of soaps, softeners, sulfonated oils, finishes and samples of fabrics, especially hosiery and knit goods, treated with same. Special stress is laid upon the new combination, water-repellent and spot-proof finishes being used.

In attendance: L. M. BOYD, WILLIAM JACKSON, JR., HAROLD MILLER, E. S. ATKINSON and JOHN F. NOBLE.

SMITH, DRUM & COMPANY

Allegheny Avenue below 5th Street, Philadelphia, Pa.

Spaces 21 to 30, inclusive

On display here is found hosiery dyeing equipment,

skein dyeing equipment, package dyeing equipment, piece goods dyeing equipment and auxiliary equipment.

In attendance: HARRY S. DRUM, W. C. DODSON, J. E. MACDOUGALL, J. M. BALLENTINE and PERRY M. PARROTT.

WARWICK CHEMICAL COMPANY
West Warwick, R. I.
Space 336

Products shown here include Impregnole Water Repellent and other specialties manufactured by Warwick.

In attendance: DR. DALE S. CHAMBERLIN and WILLIAM OSEASOHN.

JACQUES WOLF & CO.
Passaic, N. J.
Space 323

Here are displayed samples of some of Wolf's chemical specialties for processing knit goods, particularly boil-off oils, sulfonated oils, stripping agents, softeners, soluble silk oils, waterproofs, penetrants, wetting-out agents, etc.

In attendance: F. G. HENCKEL, G. J. DESMOND, ARNOLD PFISTER, C. J. RAHM, M. F. COSTELLO, C. E. WRIGHT and other members of the sales staff.

Spun Rayon Knit Fabrics

F. BONNET*

• The Application of one of the Outstanding Developments of the Textile Industry during 1936 to the Knitting Field.

THE outstanding development in the textile industry in this country during 1936 was undoubtedly the rather sudden increased use of spun rayon. From a total consumption of some 6,600,000 pounds in 1935 to over 25,400,000 pounds in 1936 illustrates the striking interest which has developed in this newer textile fiber. Its newness is really only comparative for ever since rayon was introduced in the textile field, waste from spinning and various operations was cut or garnetted and spun into yarn, but due to blockade during the world war Germany began definitely cutting rayon fibers into lengths suitable for spinning on her idle cotton and woolen machinery to supply them with raw material. This was at first considered merely an expedient brought about by war necessity so that after the war this development was almost forgotten. However, during the world depression when it became more and more difficult to finance raw materials from abroad both Germany and Italy set about again to supply man made fibers for their textile industry.

The yarn from any old rayon waste was one thing, limited in quantity and varying greatly in quality; the cut staple made with the avowed purpose for use on cotton, wool and worsted spinning machines is quite another, for such fibers are uniform in size and are quite accurately cut to any desired length. Such uniformity in the raw stock simplifies yarn spinning and makes it more economical and less wasteful. It also puts the new fiber in the position of competing with the highest grade and more valued natural fibers.

The basic development of such cut staple naturally took place in Europe because of the lack of raw materials and it was economic necessity which developed the possibilities of the new cut staple.

Cut staple, staple fiber and "Fibro" are, of course, the same, the last being the trade name of Courtaulds in England and the Viscose Company in this country. Such staple is nothing more than regular continuous filament rayon cut or chopped to the desired length and the process through the spinning is the same as for continuous filament yarns, that is to say, the same cellulose solutions are used, e.g., viscose, copper-ammonia and acetate which are pumped through jets with small orifices, but the number of holes in a jet for staple is about ten times as great as for continuous filament yarn. This means that roughly ten times the amount of cellulose solution is pumped through a jet for cut staple in a given time as for continuous filament yarn. Hence the amount of viscose or a similar solution must be made up in much larger units.

The continuous yarn as spun is gathered in spinning boxes on bobbins or reels which after scheduled periods are doffed and the resulting yarn handled as a textile material to be packaged as skeins, cones, tubes, etc. involving considerable handling. In spinning the cut staple the ends from a number of jets is gathered together in a tow or rope having 50,000 or more filaments. This rope is run directly to a cutting machine which automatically cuts the fibers into suitable lengths. The cut raw stock is then handled in bulk through the various chemical processes like bleaching, washing, finishing and drying when done by the so-called wet process. In the dry proc-

* The Viscose Co.

ess the tow is run as such through the various chemical treatments, washing, finishing and drying and is then cut in the dry state.

In both cases the finished fibers emerge ready to be baled and shipped to the spinning mills to be spun into the desired yarns. The handling of material in bulk materially reduces the cost of production so that the cut staple can be sold at about half the price of continuous filament yarn.

Mention has been made that the fiber size and staple length in this spun rayon is more uniform than any of the natural fibers which makes the yarn spinning more economical. This greater uniformity makes it possible to use fewer twists to hold the fibers together. Another interesting point is that the fibers can be made not only to any specification of filament size and staple length but the filaments may be spun of bright, semi dull or dull spinning solutions so that the possibilities in variety of construction and design seem almost limitless. It is not surprising, therefore, to find such keen interest in this comparatively new versatile fiber.

The weaving trade was the first to take an interest in the new fiber but the whole development is still very much in the initial stage. Great possibilities in its use are obvious but the question is which of these will be most successful? During the past year the linenized effect with slub yarns and the various types of challis, both plain and in prints, have been very popular.

The knitting field has been somewhat slower in developing the possibilities of spun rayon but some very beautiful fabrics have been made for outerwear.

At the present time the 1½, 3 and 5½ denier filament sizes have become more or less standard. The 1½ denier corresponds to the average cotton fiber used in this country; the 3 denier to the coarser cottons like Peruvian or the finer wools and the 5½ denier to regular wool, but some fibers have been made with filaments of 7 and 10 denier.

In the same way staple lengths have been supplied according to requirements. For cotton machinery the 1½ denier 1-7/16 inch length seems to give the best results although some has been made with shorter lengths for special purposes. For wool the filament size is usually larger and the staple lengths longer, running from 2 inches to 7 inches or even more. The choice of fiber size, i. e., denier per filament is most important to produce certain effects. For example, a yarn made of 75 per cent cotton stock dyed dark blue was blended with 25 per cent undyed 1½ denier 1-7/16 inch cut staple. The result was a nice uniform brindle yarn, rather flat and uninteresting, but when the same cotton was mixed with 25 per cent of 5½ denier instead of the 1½ denier cut staple the heavier filaments seemed to run to the outside of the yarn and give a rabbit hair effect which was much more interesting and desirable. Also a decorative effect is produced when say 10 per cent of wool is blended with 90 per cent of 1½ denier 1-7/16 inch cut staple. It is obvious that blending of regenerated cellulose type of cut staple either with wool or acetate staple can produce striking fabric effects in cross dyeing.

Having very briefly outlined the general nature and production of cut staple it is quite needless to point out that the dyeing of fabrics made from the spun yarn offers no greater difficulties than does the dyeing of the continuous filament rayon yarns. Prior to dyeing the fabrics should, of course, be well scoured to remove all oils and finishes used in the spinning, warp sizing, etc. so that the fibers may be thoroughly clean for the dye absorption. In fabrics in which starch, gelatine or similar sizes have been used on the yarn it has been found that the use of enzyme size removers has been most successful.

One of the questions asked about the newer cut staple fabrics is are they as warm as wool and this point we should like to make clear. Given a fabric of the same thickness and construction so that the air spaces within the fabric are approximately the same, then the insulation or warmth of the fabric is the same whether it be made of wool, cotton or cut staple since it is not the nature of the fibers which determines the warmth but the air spaces held within the fabric. When, however, such fabrics are washed and possibly ironed the wool fibers have an inherent resiliency which causes the fabric to spring back essentially to its original state, whereas, the cotton and cut staple tend to crush and the air spaces within the fabric are reduced causing the heat insulation or warmth to be correspondingly reduced. The above comparison is made, of course, on the clean unfinished fibers for when certain finishes are applied to the fabrics which protect the fibers from moisture and supply the necessary resiliency this difference no longer holds true.

The ordinary old oil finishes are not effective in this respect but the newer so-called synthetic resin finishes hold out great promise. Thus, some of the urea-formaldehyde condensates are quite effective in giving the fibers resiliency and resistance to permanent creasing. Others will make the fabric water repellent. This is another new field which is opening out and in which it might be said only the initial steps have been taken.

In the development of cut staple fabrics much will depend upon the intelligent application of finishes, particularly suitable to the particular purpose for which fabric is intended. This is particularly true of the wide variety of knit outerwear fabrics made of cut staple if they are to meet ultimate consumer satisfaction.

American Dyestuff Reporter
will occupy
Spaces 131-132-159-160
at the
Knitting Arts Exhibition

The Importance of a Laboratory in a

Hosiery Dyeing and Finishing Plant

• A Discussion of one of the Essential Parts of the Modern Hosiery Dyeing and Finishing Plant.

A LABORATORY is essential in a hosiery finishing plant for economy and efficiency in processing and facility in trouble-shooting. All dyes and chemicals should be standardized and each shipment checked before use. Thus, a control is established which prevents trouble and losses due to irregularities in shipments. New or competitive products can easily be tested and their importance estimated without endangering a large amount of goods. In times of trouble the reason can quickly be discovered by examination in the laboratory and the cause eliminated.

The initial equipment necessary for a small scale hosiery laboratory is meager and should pay for itself with a few months use. The primary necessities are a fine balance, a rough balance and a hot water bath. The balances can be purchased through any laboratory supply house. The hot water bath can be bought or manufactured by a mechanic at small cost. Of next importance are a supply of chemicals and reagents, a drying oven, a microscope capable of being used with low and high power magnifications and a colorimetric pH apparatus. Other special laboratory apparatus may be added as the need arises and as the size and purposes of the laboratory may be increased.

The fine balance need not be an expensive one. An accuracy of one one-hundreth of a gram is sufficient. The rough balance should have a capacity of three pounds. The hot water bath needs a closed coil steam line heating a strong saline solution (calcium chloride, generally). There should be sufficient salt in solution to give a boiling point of 110° C. For a list of necessary chemicals and reagents see "Analytical Methods for a Textile Laboratory" by Walter M. Scott (1935-36 Year Book A.A. T.C.C.).* The drying oven should have a temperature control mechanism. For most fabric examinations a low power microscope is most useful. There are several inexpensive types of low power microscopes on the market. Of course, an instrument capable of both low and high power work is best. A colorimetric pH apparatus is simple to operate and very useful.

*Reprints are available through the secretary of the American Association of Textile Chemists & Colorists at 75c per copy.

Since the laboratory is of greatest importance to the dyehouse its cost should be carried by the dyehouse. Invariably the savings, brought about by the laboratory, more than pay for the investment involved. Either through the introduction of dyes and chemicals that give better money value than those in use or by improvements in processes that make a more saleable product.

In a very small plant the work in the laboratory should be done by the dyer. In a plant that cannot profitably employ a full time chemist, one should be engaged to spend part time as assistant to the dyer in the dyehouse and part time in the laboratory. A large plant will find it economical to employ one or more chemists to work entirely in the laboratory.

Simple procedures are generally satisfactory in testing dyes and chemicals. The above mentioned "Analytical Methods for a Textile Laboratory," contain all the procedures necessary for chemicals used in a hosiery dyeing and finishing plant.

Dyes are tested by dyeing a swatch of tubular knit fabric containing bands of silk, cotton, viscose and acetate. The method of dyeing should closely follow that used in the dyehouse; employing the same percentages of assistants, the same volume of liquor (or, since this varies, an average standard) for the length of time a batch is run until the first sample is taken. Dyeings made in light and heavy percentages serve not only to obtain the effect on various fibers but also as a means of identifying the dyestuff. Samples should be taken from the first shipment of a dyestuff and all succeeding shipments checked against the original for uniformity. It is necessary, when checking a shipment, to make similar dyeings with the original at the same time.

To identify a dye several methods are used. First, the dye should be blown out to discover if it is a mixture. There are three popular methods of doing this. One is to blow a small amount of dye from the end of a spatula onto a wet filter paper. Differently colored specks denote a mixture. Another method is to scatter a little dye into a glass cylinder of cold water and observe the streaks of dissolving dyestuff. Probably the best method is to blow out the powder into a shallow porcelain dish containing

concentrated sulfuric acid; this discloses a mixture even though the water solutions of the dyes are similar. If it is not a mix it can be identified by its color reactions with various reagents. Into several test tubes a small amount of dry dyestuff is placed and various reagents added, one in each tube, and the color noted. By comparing the color reactions with those of known dyes it is possible to identify the dye. A simpler procedure is to make a solution of the dye and dip a filter paper into it. Drops of various reagents are placed on the filter paper and the reactions noted. The methods of the A.A.T.C.C. are standard for fastness tests.

Finishes and boil-off agents can be tested by running a pair of hose in the manner recommended. If the results are interesting a batch can be run in the dyehouse; if of no interest the necessary information has been obtained without risking a large batch as would have to be done if it were tried directly in the dyehouse.

Trouble-shooting covers a good deal of territory. A few tests and a little common sense generally disclose the nature of the fault. Rinsing in lukewarm water removes streaks (due to improper dyeing), spots of finishing gums, blood, sugar and salt. Washing in lukewarm soap takes care of dirt, soapscum, grease, oil, chalk and pigments. If spots persist after washing, further treatments are necessary: oxalic acid for iron (rust), amyl acetate for paint (fingernail lacquer), alcohol for indelible pencil marks, hydrosulfite for dye stains, carbon tetrachloride for chewing gum and heavy grease and hypo for iodine stains. Once the nature of the trouble is known, tracing and eliminating the cause is a matter of experience and knowledge of mill routine.

In view of the fact that a laboratory economically provides a means whereby assurance is obtained that the firm gets full value for money spent on materials, that the value of new or substituting materials can be ascertained, that possible savings by changes in procedure can be investigated and that troubles can quickly be traced and the causes eliminated, every hosiery finishing plant should invest in one.

Consumer Knit Goods, Hosiery Requirements

EPHRAIM FREEDMAN*

• A Discussion of Knit Goods Wet Processing from the Consumer's Viewpoint.

THOUGH there have been many advances in the art of finishing and dyeing of knit goods and of hosiery, much remains to be done from the consumer's viewpoint. The object of this article is to list some of the problems in the hope that finishers and dyers can solve them.

Consumers would like to have:

1—Roman-striped hose of cotton for their children, and Roman-striped polo shirts and caps, the colors of which will not stain during the washing process.

2—Children's hosiery that do not shrink excessively.

3—Bathing suit materials in light shades that disclose fairly good color permanence.

4—Women's hosiery that offer better resistance to runs and snags.

5—Dyed fabrics offering better resistance to perspiration.

6—Men's rayon socks that do not bleed profusely.

7—Cashmeres, camel's hair and fine wool sweaters that will not easily shed, nub, or rough up, particularly under the armpits.

8—Moth-resisting finishes which are not removed by washing or dry-cleaning.

9—Finishes that are really "splash resistant" after washing.

10—Permanent water-repellent finishes, and last but not least,

11—Informative labeling.

We are told that Roman-striped hose are not made in the U. S. A., and therefore the problem of staining cannot be solved. Surely, there must be at least one domestic dyer and finisher who would want to investigate.

Much ill-will results when children's hosiery shrink excessively, sometimes up to 17 per cent. Proper laboratory testing followed by a little plant research would do much to reduce the shrinkage and incidentally the returns.

Many products are brought forth as panaceas for runs and snags. Some are accompanied by laboratory reports attesting their improved resistance. So far we have seen no test method capable of correctly evaluating run and snag resistance, although some laboratories misinterpret abrasion tests as being such an index.

While rayon socks generally do not fade materially, they do as a rule bleed profusely, sometimes when being worn. Does not this indicate the need for improved dyeing technique?

Fine fleeces like baby's skin must be handled and worn

*Director, Macy's Bureau of Standards, R. H. Macy & Co., Inc.; Past Chairman, New York Section, A.A.T.C.C.

with care. People who are hard on their clothes yet who like fine textured knitwear might be induced to purchase more if some fairly permanent wear-resistant finish could be applied to this type of knitwear.

Recently we ran across a moth-resistant product which seems to work even after the fabric is washed. Now what is needed is more knitwear, properly treated.

Many preparations are offered for application to stockings so as to prevent spotting or water-staining. These products are for sale over many counters. While they lure consumers on to buy, probably they are seldom repurchased because of their usual lack of permanency. Finishers might well consider the problem of giving stockings a fairly permanent finish elastic enough to be suitable for use. Not an easy problem this one, but it will probably be solved in the near future.

Of what use are water-repellent finishes on garments that are likely to be washed if the finishes are not permanent? So often are we asked to approve a water-repellent finish which upon investigation proves to be of only a temporary nature.

Before the close of 1937 there will be a very widespread and insistent demand for informative labeling. The use of the term "commercially fast," now still in vogue in some dye houses, is already on the toboggan because consumers demand sense instead of nonsense. So also are terms like sunfast. A simple consumer terminology is in the making. Dyers and finishers who subscribe to the principle that consumers are entitled to know what they are paying for and will mark their commodities accordingly will experience little difficulty in disposing of their merchandise.

The author has always welcomed contact with dyers, finishers and knit goods manufacturers who are capable of producing merchandise of outstanding quality. Only too often, however, does he find that claims are not substantiated by test. The answer is quite obvious.

We cannot talk the same language if dyers, finishers or knit goods manufacturers use different yardsticks for measuring characteristics.

The Year Book of the American Association of Textile Chemists and Colorists provides most of the test-methods, and in the majority of instances the terminology necessary for the evaluation of results.

Why not use the Year Book more often, employ the tests described therein and help solve the problems enumerated previously in this article?

—♦♦—

Overdose of

Moisture Causes Corrosion

E. M. SCHENKE*

• A Discussion of the Use of Moisture as a Lubricant for Knitting Yarns.

MOISTURE is considered one of the best lubricants for knitting yarns whether silk, rayon, cotton or wool. It surely is the cheapest and one of the most common.

Since moisture, that is water, is so cheap and such a good softener, knitters use it freely and often do not realize the amount of damage which can be done, if it is not controlled.

Yarns for knitting should be thoroughly and uniformly conditioned but they should not be saturated with moisture if corrosion of needles and sinkers is to be avoided.

The knitter's objective in the use of moisture is to avoid the possibility of sleazy knitting which he knows is caused by hard and dry places in the yarn. Sleazy knitting, by the way, is the formation of irregular stitches or rows of stitches.

Silk or rayon which has been standing for a long time on cones will dry out and lose a large percentage of its moisture. This may also occur with silk or rayon during transit from throwster or rayon manufacturer. As a result the silk in the center of the cone may be in good condition but the silk on the outside entirely too dry and the amount of moisture that the yarn can absorb from the atmosphere may be too little for the production of a good fabric.

This condition therefore calls for the addition of moisture to the yarn. The measures usually resorted to saturate the yarn. These measures may be:

1. Spraying the cones on the knitting machine with a spray gun.
2. Setting cones on pads saturated with water.
3. Running the yarn over water- or emulsion-carrying rolls on the back of the knitting machine.
4. Running the yarn through water or through an oil emulsion.

When silk yarn is saturated with water the sericin on the silk tends to loosen and to be deposited on the needles and sinkers of the knitting machine. This nearly always leads

*Research Associate at the National Bureau of Standards for the National Association of Hosiery Manufacturers.

to trouble. The metal parts of the machine coming in contact with the yarn become corroded and pitted. The pitting of the needles and sinkers on a hosiery knitting machine causes unsightly streaks in the knit fabric which usually appear as fuzzy lines down the stocking.

The pitting and corrosion are promoted by atmospheric oxygen and by free acid in the softening oils used on the yarn. An accumulation on needles and sinkers of sericin, oil, and moisture containing oxygen may act as a concentration cell and the electrolytic action set up will accelerate the corrosion.

In order to combat corrosion, acid oils should be avoided, all movable parts on the knitting machine which come in contact with the yarn should be examined at frequent intervals, and thoroughly cleaned at least once a week. It is important to keep the needles and sinkers as well as the rest of the metal surfaces of the machine covered with a thin film of good stainless oil which will cling tenaciously to the surfaces.

A little care in the selection of softening oils, periodical examination of the machine to see that it is kept clean and the metal surfaces thoroughly coated with oil, and moderation in the use of water on the yarn will to a large degree reduce corrosion of knitting machines.

One of the first rules for quality knitting is a perfectly adjusted machine; a second rule, thorough and uniformly conditioned but not saturated yarn.

Full Fashioned Hosiery

A. L. BRASSELL*

• An Article presenting the Subject of the Manufacture of Hosiery which should Prove of Interest to the Wet Processor as a Source of General Information.

TYPES OF HOSIERY

Full-fashioned and seamless are the common methods of knitting hosiery. In seamless stockings the same number of needles are engaged and the same number of loops are formed in knitting each course, from ankle to top, whereas in full-fashioned stockings the knitting needles are successively disengaged and the corresponding number of loops are dropped so as to properly narrow the stocking and make it conform naturally to the shape of the leg. Because of the better fitting qualities of full-fashioned stockings and their proper fashioning for snug appearance this type is demanded by well dressed women. This article deals primarily with full-fashioned hosiery, although much of the information may be applied to seamless hosiery also.

YARNS USED IN FULL-FASHIONED STOCKINGS

Chiefly because of its high elasticity and strength, silk continues to remain as the most desirable material for full-fashioned stockings. By elasticity is meant the ability to stretch when under tension and to regain original measurements after the stress has been removed. Silk possesses in an unusual degree this ability to regain its original length when the tension has been removed. The stretch of a stocking depends not only upon the elasticity of the yarn but also upon the special construction of knitted fabric which permits stretch in any direction. With the present low price of silk there is no immediate danger of silk being markedly replaced by rayon in this field. Because of the unusual demands of high strength in sheer fabrics, high and permanent elasticity and a snugly fitting garment, silk will continue for many years to predominate in women's hosiery. In parts of the stocking that are subject to unusual wear, and where not exposed to view, mercerized cotton yarn is usually knit along with the silk in order to add strength and durability. Such re-inforcement is used in toes, heels, soles and back fold of the welt. Silk is used as the facing yarn in all re-inforcements parts, at least in the better grades of stockings.

The early use of rayon in full-fashioned stockings met with much disfavor because of its objectionable shiny, metallic appearance, its low elasticity, and low tensile strength, especially when wet. These objections have been partly overcome,—the wet strength has been increased, the elasticity has been improved, and today rayon can be produced in any desired degree of dullness. Indeed, the dull appearance of present day rayon is a permanent quality which can be produced in any degree desired and cannot be removed in washing. Despite these improvements rayon has still far to go to meet the high elasticity and strength of silk when wet. Present day rayon possesses less than one-half of the strength of silk when dry and less than one-fourth of its strength when wet, for the same size yarn. A few years ago, it was common practice to combine rayon and silk yarns in knitting stockings, plating the silk outside of the rayon so

* United States Testing Company, Inc.

that the silk appeared on the outside and rayon on the inside. Again, with the low price of silk and the trend for even sheerer stockings this practice has largely disappeared. The presence of such plating is evidence of deliberate cheapening. Although rayon has largely replaced silk in many types of dress goods and draperies, in full-fashioned hosiery, silk is still supreme.

CONSTRUCTION OF YARN

The raw silk skeins used in making hosiery yarn consist of a single strand of Japanese silk, usually of 14 denier size. A unit denierage means that 9,000 meters of silk weight—one gram, or, a denierage of 14 means, that 9,000 meters weight—14 grams. The silk yarn is made by combining two or more of these threads and twisting into a single yarn. When two threads are combined the yarn is known as a two-thread (or 28 denier), when ten threads are combined together, the yarn is known as 10 thread (or 140 deniers), etc.

The amount and kind of twist placed in yarn greatly influences the appearance of the stocking. Tram silks are made by twisting all strands together in the same direction. Twists from three to five turns per inch are inserted in Tram silks, usually the latter value. In the majority of present day hosiery yarns the twist runs from 10 to 25 turns per inch. In Grenadine, formerly extensively used, the single ends are given a left twist, 36 turns per inch and then doubled into right twist, 32 turns per inch. In Crepe yarn for hosiery, crepe yarn right twist and crepe yarn left twist are combined into a single yarn with 2½ to 5 turns right twist. This construction gives a balanced yarn with little tendency to kink.

An increase in twist increases proportionately the dullness of fabric. Besides increasing dullness the increased twist produces a sheerer effect with less covering power, reduces tendency to snag, and offsets the appearance of distorted loops. High twist adds greatly to the cost of finished stockings. During the past year, there has been a steady expansion in the sale of crepe hosiery. True crepe stockings have certain features not found in the lower twist constructions. During the present season, many attempts have been made to cheapen the construction of crepe hosiery by making stockings of lower twist than is known as crepe but still selling the hose as "crepes." There has been a growing demand during recent months for the trade to establish minimum standards for crepe yarn for hosiery in order to minimize buyer confusion and avoid consumer dissatisfaction through misrepresentation.

Last August, minimum twist measurements for hosiery designated as crepe were made public by the National Association of Hosiery Manufacturers.

RECOMMENDED MINIMUM TWIST REQUIREMENTS FOR HOSIERY DESIGNATED AS "CREPE"

Hosiery, in order to be designated as "Crepe" should be constructed, in the body or boot of yarn in which the total of the turns in both the initial and final twists is at least—

100 turns per inch for two-thread
80 turns per inch for three-thread
60 turns per inch for four-thread
50 turns per inch for five-thread or over.

At least 50 per cent of these minimum twist requirements should be in the initial twist, which may be either right or left, or both.

The following are illustrative examples of the above minimum twist requirements:

Two-thread	1-50) 50 1-0)	1-25) 50 1-25)	1-35) 30 1-35)	1-40) 20 1-40)
Three-thread	1-45) 1- 0) 35 1- 0)	1-15) 1-15) 35 1-15)	1-30) 1-30) 20 1- 0)	
Four-thread	1- 9) 1- 9) 24 1- 9) 1- 9)	1-16) 1-16) 28 1- 0) 1- 0)	1-30) 1- 0) 30 1- 0) 1- 0)	

CLASSIFICATION OF FULL-FASHIONED HOSIERY AS TO SERVICE

The first natural classification of full-fashioned hosiery is based on weight or size of yarn in boot. During the last ten years the trend of styles has been steadily towards sheerer stockings. Unfortunately, with increasing sheerness, durability decreases. In hosiery which is sheer the higher cost is due to increased construction costs and the necessity of using better grades of silk even though less silk per pair is used. In the manufacture of sheer hosiery the production of seconds and sub-standards becomes unusually high, thus increasing the cost of firsts.

The weight of full-fashioned hosiery is classified according to the size or number of threads of silk yarn used in the leg as follows:

Very sheer stockings—two and three-thread.
Sheer stockings—four and five-thread.
Semi-service stockings—seven-thread.
Full service stockings—ten-thread.

At the present time the great majority of full-fashioned stockings appear in sheer weights of four-thread silk. Naturally durability and wear will increase as selection is made in the heavier sizes but for evening wear ladies will demand the sheerest despite cost and durability. For economy in hosiery a variety of weights should be selected by the consumer to fulfil the various needs of service and of evening party wear. The different weights should be used to suit the particular occasion.

APPEARANCES OF HOSIERY

Grades

In every hosiery mill the stockings are graded as perfect, seconds and sub-standards depending upon the defects or variations which appear in the final product. Definite standards and recommendations for labeling have now been set up and adopted by the industry.

Rings

Perhaps the most unsightly defect in stockings is the presence of bands or rings of color shadings. These rings are generally caused by uneven silk and indicate that the

original raw silk was not of even size. In the past, this defect has been eliminated only by the selection of very even silk of high price. Today the problem is partly solved by the three-carrier system of knitting whereby a more even appearance is obtained by knitting from three cones in consecutive courses, thus restricting any rings to single courses instead of to wide bands. The differences in yarn sizes are scarcely apparent to the eye when restricted to single courses.

Two Tone

This defect is manifested by shadows which appear between leg and foot portions, caused by differences in yarn size, nature of silk, an improper joining of foot and leg and variation in stitch formation.

Yarn Defects

Many defects appear in raw silk, such as nibs, corkscrews, slugs, waste and loose ends. These defects may carry over into the finished stocking and are the main cause of grading into seconds. In the finished stocking, these defects appear as thick streaks, thin streaks, and fuzziness.

Vertical Stripes

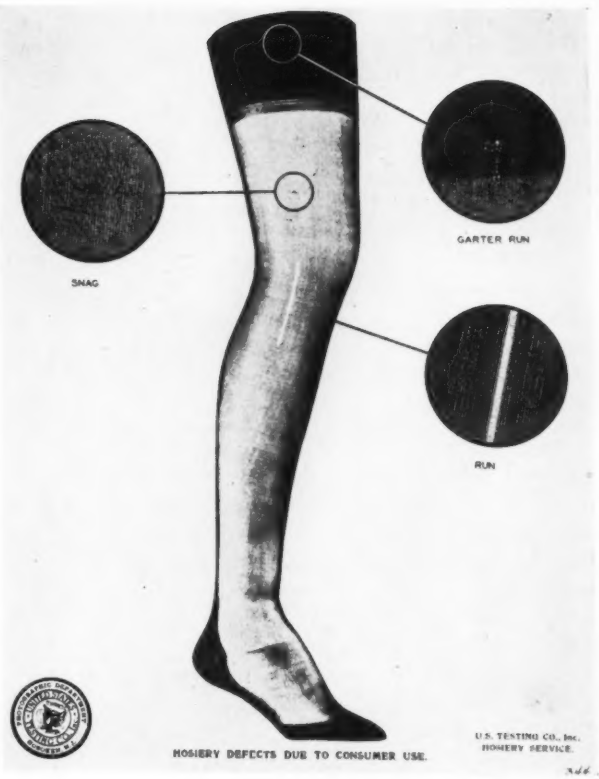
Vertical stripes appearing in finished hosiery are a knitting effect due to unequal travel of sinkers in knitting.

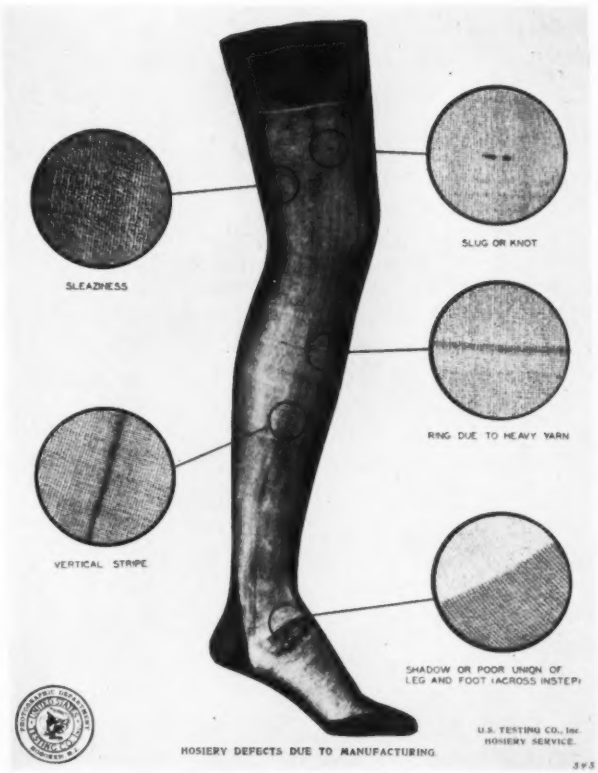
Finishing Defects

These qualities are often overlooked by the buyer but are most important because the appearance of the stocking means so much when offered for sale over the counter. Such things as uneven dyeing, unequal shading of cotton and silk, creases and wrinkles and distorted loops should be looked for. A sleazy stocking due to crooked stitches makes an unsightly stocking. The presence of stains may appear where inspection is not rigorous.

TEXTURE OF FABRIC

Assuming that no defects are present the most important factor in the appearance of a stocking is the texture or closeness of knitting. This depends upon features of construction. Full fashioned knitting consists of a continuous series of loops extending in rows running across and lengthwise of the stocking. Alternate rows of loops which run lengthwise of the stockings are designated as wales, each wale corresponding to one needle used in knitting. Each row of loops running crosswise of the stocking is designated as one course. The fineness of texture is dependent upon number of threads, wales per inch and courses per inch. A high number of courses and of wales per inch indicates the presence of small loops and hence a fine, close texture. The general trend in hosiery manufacture has been towards a finer texture which is accomplished by using a finer gauge machine and knitting courses closer by adjusting the travel of sinkers and dividers. In the trade the fineness of texture is indicated by reference to the gauge used in knitting. The gauge of a stocking is the number of needles per 1½-inch space on the needle bar. Unfortunately for checking, this does not correspond to the number of wales per inch in the finished stocking because the size of the stocking is altered after knitting by




SLEAZINESS
SLUG OR KNOT
RING DUE TO HEAVY YARN
VERTICAL STRIPE
SHADOW OR POOR UNION OF LEG AND FOOT (ACROSS INSTEP)
HOSIERY DEFECTS DUE TO MANUFACTURING.
U.S. TESTING CO., Inc.
HOSIERY SERVICE.

the finishing operations of boiling-off, dyeing and boarding. The relation between total needles and gauge for different widths of needle bar in use is given in the following chart.

GAUGE CHART

Gauge	*Needles per Inch in Machine*	*13" Head*	*13½" Head*	*14" Head*
39	26	338	351	364
42	28	364	378	392
45	30	390	405	420
48	32	416	432	448
51	34	442	459	476
54	36	468	486	504
57	38	494	513	532

From the above chart it will be noted that a stocking counting 364 needles may either be a 39-gauge knit on a 14-inch head or a 42-gauge knit on a 13-inch head. If both stockings were boarded to the same size, it is apparent that one knit on a 14-inch head will give greater service as to stretch. From the given gauge number and the total number of needles in the welt, the width of needle bar employed can be at once calculated. An unusually short needle bar means that little stretch will be obtained at the knee and that yarn has been skimped in knitting.

Hose knit on a 14-inch head are more or less accepted as the standard. All hose are not knit on the exact head widths of 13", 13½" and 14", as the yarn guides may be set for any traverse to give the width desired. For example, a 42-gauge hose may be knit on 392 needles using the full 14-inch head, or the traverse may be set so that 388 or 380 needles are used in the knitting. The gauge of the hose remains the same, but the width becomes narrower.

DULL APPEARANCE IN STOCKINGS

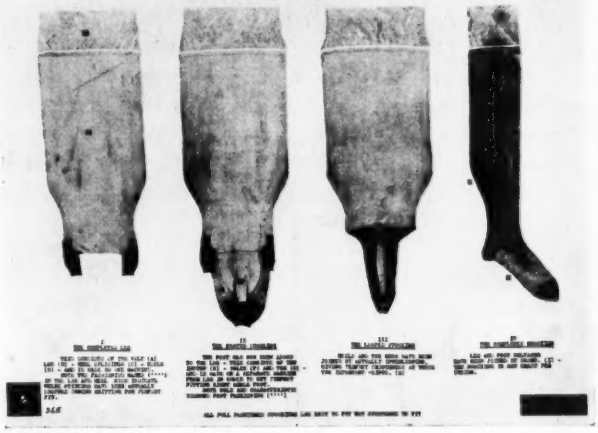
Silk itself has a pleasing low-luster appearance but to accentuate the dullness in contrast with lustrous rayons, special dulling methods are used. In some mills a special finishing agent is added during or after dyeing. Highly dispersed insoluble soaps have been successfully used for this purpose. Such dulling agents rarely exceed two per cent of the weight of the silk and resist several washings before removal. The dulling agents added to silk stockings are not considered as weighting.

The continued demand for low luster silk stockings has also been met by the introduction of high and special twist yarns. To this end, high twist tram, crepe and grenadine yarns are used in stockings. Other advantages of high twist have been previously mentioned.

SIZE OF STOCKINGS

The size of stockings is based chiefly upon the size of foot, ranging from size 8 to 11, size 9½ being the most common. The length of all sizes of finished stockings should be thirty inches, with a tolerance of plus or minus one inch. Lengths of 31 or 32 inches are made in special cases. Most stockings are boarded on standard forms. When different width needle bars are employed in knitting, different results will result after boarding even on

STEPS IN THE MANUFACTURE OF FULL FASHIONED HOSIERY



standard forms, due to contraction after boarding. If such contraction does not occur a variation in texture will result due to variation in total needles employed. Thus a shortened width of needle bar will mean a saving in silk, but also will result either in an undersize boot or in a coarser texture. For *over size* stockings a specially wide needle bar is employed in the knitting machine and the stockings are boarded on special over size boarding forms.

CONSTRUCTION OF HOSIERY

Much has already been said regarding the construction of hosiery relative to wales, courses, total needles employed, method of knitting and size. Also, the size and construction of yarns have been described. Many other features are of special importance, such as the size and extent of reinforcement in parts subject to unusual wear, such as in the toe, sole, heel and welt. The reinforcements at the toe of the hose would be large enough to come well up over the joint of the large toe, which may wear out quickly if skimped by the hosiery manufacturer.

Sandal hose are made of the sheerest quality and manufacturers cannot put reinforcements anywhere except on the sole, sometimes a slightly heavier toe tip, and a narrow heel. This is necessary of course because of the very open shank and sometimes open toe that comes in the summer and evening sandal. Consumers should know that they cannot expect exceptional wear from this type of hose.

OTHER SPECIAL HOSIERY FEATURES

Employment of three-carrier knitting.
Extra stretch in welts.
Adjustable lengths.
Knee-high and anklet sizes.
Special reinforced toe and high splice heel.
Cradle foot construction.
Two-way stretch.
Ingrain yarns.
Clock works.
Picot edge.
Run stop course at welt.
Rubberized yarns for dulling.
Waterproof and showerproof stockings.
Special snag resisting features.

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American Association of Textile Chemists and Colorists

APRIL 19, 1937

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Members should notify the **Secretary** immediately of all address changes

ANALYTICAL METHODS

The Council has authorized the republication of the "Analytical Methods for a Textile Laboratory" in the 1937 Year Book. The committee in charge of this section will be glad to correct any errors or omissions in these methods as published in the 1935-36 Year Book. The members of the A. A. T. C. C. are therefore requested to review these methods and send to the chairman of this committee not later than March 15, 1937, any suggestions for the improvement of the existing methods or any new methods which seem suitable to include in this section.

Walter M. Scott, Chairman,
857 Boylston Street,
Boston, Massachusetts.

REPRINTS

Analytical Methods

Reprints of the Analytical Methods as printed in the 1935-6 Year Book are now available from the secretary of the Association for $.75 per copy postpaid.

CALENDAR OF COMING EVENTS

Meeting, New York Section, April 23, 1937, Swiss Chalet, Rochelle Park, N. J.

* * *

Meeting, Northern New England Section, Andover, Mass., May 7, 1937.

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Annual Outing, Philadelphia Section, White Marsh Country Club, Philadelphia, Pa., May 14, 1937.

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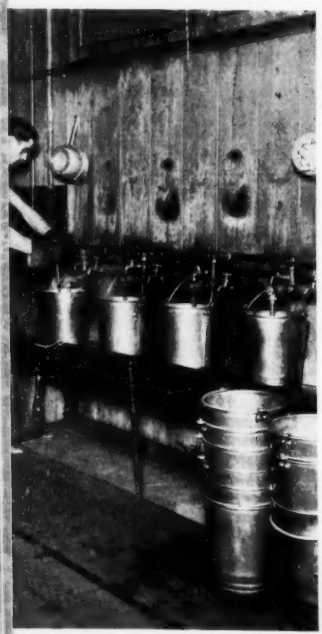
Summer Outing, Piedmont Section, Ocean Forest Hotel, Myrtle Beach, S. C., June 25 and 26, 1937.

* * *

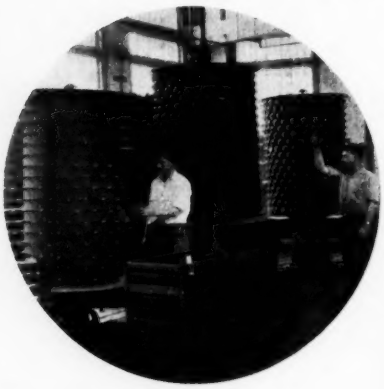
Annual Meeting and Convention, December 3 and 4, Bellevue-Stratford Hotel, Philadelphia, Pa.

Use of Monel in the Knit Goods and Hosiery Industry

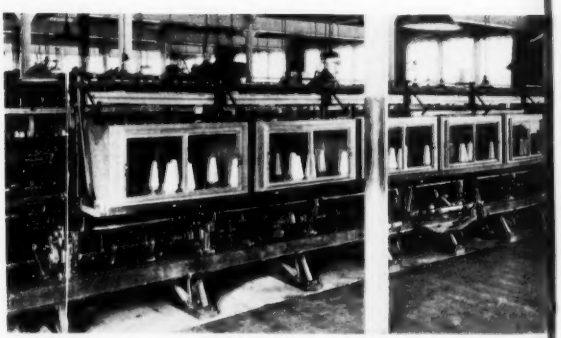
ABOVE—View Showing some of the Monel Hosiery Dyeing Machines at the Plant of the Gotham Silk Hosiery Co., New York. The Truck is lined with Monel.



ABOVE — Mixing Dyestuffs in Monel Pails preparatory to adding to the Dyeing Machines.

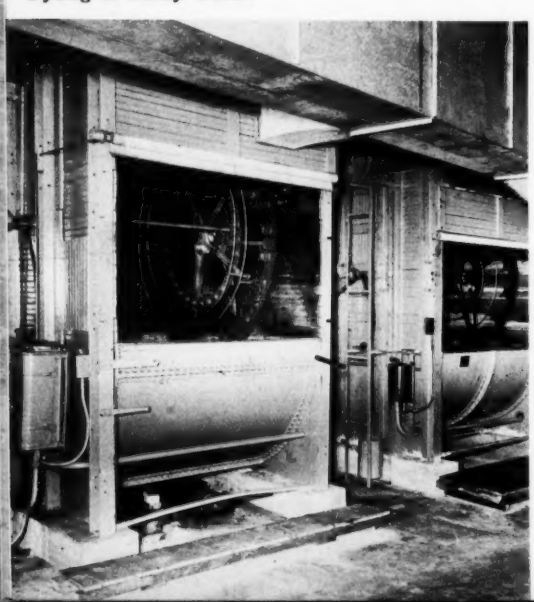


LEFT—Package Dyeing Machine equipped with Monel Spindles and Tubes in use at the Thies Dyeing and Pressing Co., West Warwick, R. I.



ABOVE—Full Fashioned Hosiery Machine equipped throughout with Monel Moistening Boxes and Troughs.

BELOW — Monel equipped Giles Skein Dyeing Machines at the Plant of Malina & Co., New York. While not limited in their Range of Usefulness, these Machines at Malina & Co. are used chiefly for the Dyeing of Fancy Yarns.



BELOW — Smith Drum new type Skein Dyeing Machines constructed of Monel. These Machines are regularly used with Cotton, Silk, Rayon and Woolens.

Some Characteristics of

Monel and Other Nickel Alloys

Relating to the Textile Industry*

G. L. COX†

TO the textile chemist, the principle use of a metal lies in its ability to withstand corrosion by those processes occurring in the production of a finished piece of fabric. As early as 1905, the year that Monel was commercially available, the work of the chemist ended when the methods for a particular dyeing, or manufacturing process, were completed in the laboratory. Today, the role of the chemist and chemical engineer has been extended to the point where a large portion of their thought and efforts are directed along the lines of choosing the proper metal equipment in which the process can be carried out most economically and with assurance of first quality product. The result has been the adoption of corrosion resistant materials for those vital phases of production where long life of the equipment and freedom from metallic contamination are first-order requisites. The producers of corrosion resistant materials have been, therefore, benefitted by the efforts of textile chemists in establishing usefulness of modern corrosion resistant materials.

Most outstanding among the corrosion resistant materials, proven by years of service to be useful in textile applications, is Monel. Almost concurrent with its old age, Monel has found practically universal use among the various textile applications. Today, a vast amount of experimental information and operating data are available to assist the textile chemist and engineer toward the selection of the proper material for the specific job. The position of Monel is such that improper or unprofitable use of the alloy is extremely rare. If it occurs, it is usually the result of failure to take the proper steps to secure information that is available for the guidance of the user of the material.

Monel is a natural alloy containing approximately two-thirds nickel and one-third copper, with small percentages of iron, manganese, silicon and carbon. The strength and corrosion resistance of the alloy are not sensitive to small changes in its chemical make-up, so that as a result of the careful control employed in its production, Monel has an enviable record of uniformity of properties from lot to lot, over years of time.

While Monel is commonly known as a corrosion resistant material, it possesses, at the same time, outstanding physical and mechanical properties. These properties alone often justify the use of Monel in many applications. The physical constants of Monel are given in Table 1; the important mechanical properties of Monel are summarized in Table 2. It may be noted that the mechanical properties of Monel are superior to most other non-ferrous alloys and mild steel. In some forms, Monel compares favorably in mechanical strength to heat-treated alloy steels. These properties of Monel permit its use for the construction of equipment without sacrifice of strength, with the added advantage of exceptional corrosion resistance. It is also significant that the high strength of Monel is available without sacrifice of softness, or ductility, so essential in fabrication of equipment. Monel can be readily worked in any shop equipped with facilities for handling ordinary mild steel, galvanized iron, or other more common non-ferrous materials.

Most outstanding amongst those applications, where Monel is used for its high strength, as well as resistance to corrosion, erosion, and wear, is for valve seats in the huge 32-foot diameter valves controlling the flow of water through Boulder Dam. Mechanical tests on the Monel used in this installation showed an average tensile strength of over 100,000 pounds per square inch and ductility evidenced by elongation of over 30 per cent in 2 inches.

Of general interest is the fact that Monel retains its high strength at elevated temperatures, as shown in Table 3. In this respect, it is superior to mild steel and high copper alloys such as brasses and bronzes. For this reason, Monel is used widely for valves, valve trim, gaskets, plungers, and miscellaneous equipment handling steam or atmosphere at high temperatures and pressures.

It is a common fault of carbon steel and many alloys to suffer serious loss in ductility and toughness at low, or sub-zero temperatures. For example in one test, a sample of steel of a carbon content of 0.4 per cent, showed an elongation of 31 per cent in two inches at room tempera-

* Presented at meeting, Southeastern Section, February 13, 1937.
† Development and Research Division, The International Nickel Company, Inc.

TABLE 1

Physical Constants of Monel

Density, gms. per cc.		8.80
lbs. per cu. in.		0.318
Melting Point, °F		2370-2460
°C		1300-1350
Specific Heat (20°-400°C.)		0.127
Coefficient of Expansion	(25°-100°C.)	0.000014
	(25°-300°C.)	0.000015
Electrical Resistivity-microhms per cu. cm.		42.5
ohms per circ. mil. ft.		256
Coefficient of Electrical Resistivity, per °C		0.0019
per °F		0.0011
Modulus of Elasticity, lbs. per sq. in., in Tension		26,000,000
in Torsion		9,500,000

TABLE 3

The Effect of Temperature on Tensile Strength of Monel

Temperature Degrees F.	*Average Values Tensile Strength psi*	*Yield Strength 0.2% Ext. psi*
Room Temperature	85,000	33,000
300	81,000	28,500
600	79,500	26,500
700	76,000	26,500
800	70,000	25,375
1,000	50,500	24,000
1,200	32,000	18,350

TABLE 2

Mechanical Properties of Monel

	Tensile Strength psi.	*Yield Strength 0.5% Ext. psi.*	*Proportional Elastic Limit psi.*	*Elongation in 2 inches per cent*	*Reduction in area per cent*
Rod and bar					
Cold drawn					
Annealed	70,000- 85,000	25,000- 35,000	20,000-30,000	50 - 35	75 - 65
As drawn	85,000-125,000	60,000- 95,000	45,000-75,000	35 - 15	65 - 50
Hot rolled	80,000- 95,000	40,000- 65,000	25,000-40,000	45 - 30	65 - 50
Forged	80,000-110,000	60,000- 85,000	45,000-65,000	40 - 20	70 - 50
Wire, cold drawn					
Annealed	70,000- 85,000	25,000- 35,000	20,000-30,000	45 - 25	
No. 1 temper	95,000-110,000	65,000- 85,000		25 - 15	
Regular	110,000-140,000			15 - 8	
Spring	140,000-175,000			8 - 2	
Plate, hot rolled					
As rolled	80,000-110,000	40,000- 90,000		55 - 25	
Annealed	70,000- 85,000	25,000- 45,000		60 - 50	
Sheet and strip					
Standard sheet	65,000- 80,000	25,000- 35,000	20,000-30,000	40 - 25	
Cold rolled					
Annealed	65,000- 80,000	25,000- 35,000	20,000-30,000	40 - 25	
Full-hard sheet	100,000-120,000	90,000-110,000		8 - 2	
Full-hard strip	100,000-125,000	90,000-115,000		8 - 2	
Tubing, cold drawn					
Annealed	65,000- 80,000	25,000- 35,000	20,000-30,000	35 - 25	
As drawn	90,000-105,000	60,000- 75,000		20 - 15	
Casting					
Regular	60,000- 80,000	30,000- 40,000*	18,000-25,000	40 - 20	40 - 20
Hard	70,000-115,000	45,000- 90,000*	25,000-80,000	20 - 1	20 - 1

*0.1% Ext.

ture, but dropped to about 7 per cent in 2 inches at —310°F. Monel not only retains its high ductility at this low temperature, but also suffers no loss in impact property, so important in low temperature applications subjected to sudden shock. The ability of Monel to retain high strength, ductility and impact resistance at low temperatures has led to its wide use for containers handling liquefied gases, or extremely low temperature reactions.

The amenability of Monel to all forms of mechanical hot or cold working, or joining by welding, soldering, brazing, or silver soldering, makes it possible to take advantage of its desirable physical and chemical properties. It is also significant to note that Monel does not suffer loss of its corrosion resistance when subjected to the heat of welding or high temperature brazing or soldering.

While the mechanical properties of Monel make it outstanding among those materials useful in many applications, this property alone could not account for its extensive use in the chemical industries, such as the textile industry. Of more importance in such industries is its excellent resistance to corrosion by the many and varied corrosives involved. In this connection, it is interesting to note that the textile industry is among the largest users of the basic chemicals, such as sulfuric acid, caustic soda, acetic acid, sodium sulfate, sodium carbonate, starch, salt, and many others. The list of chemicals used in the textile industry includes some of the most corrosive compounds which metals are called upon to withstand.

The problem of the textile chemist is important, in that the metal, or alloy, selected for any particular job must be not only long-lived, but also sufficiently resistant to attack by the corrosives so that no harmful contamination of the solutions occurs, which may eventually result in staining of the goods being processed. The substitution of Monel for other materials would be justified even if the metal conferred no other advantage. Following in close relationship with this property of Monel, the smooth surface of Monel, as well as other corrosion resistant ma-

terials, prevents absorption of dyestuffs during dyeing operations, as occurs with wood or other porous non-metallic materials. The non-absorbing property of metals permits quick changes of colors, especially from dark to light, in the same dyeing equipment, and avoids the usually necessary and long boiling-out processes. It is, therefore, possible to carry out production dyeing with fewer Monel tanks than would be required with wood or porous non-metallic material. Also it is often possible to process a piece of goods completely through the bleaching, rinsing, scouring, and dyeing operations in one tank.

The wide and extensive use of Monel in industries other than the textile industry reasonably suggests a brief discussion of the property of Monel giving it its corrosion resistance. The resistance of Monel to corrosion is probably due to the basic characteristics of its two main constituents—nickel and copper. Both nickel and copper are inherently resistant to corrosion; that is, from the electro-chemist's viewpoint, they are reluctant to replace hydrogen from solutions with which they may be in contact. The qualitative tendency of metals to corrode may be summarized in a tabulation such as is given in Table 4. The tendency of the most important metals to replace hydrogen from a solution is indicated by their position in the electro-motive series in the table; thus, the position of metals in this series provides at least a rough measure of their tendency to corrode. Given along with the theoretical electromotive series is another series called a galvanic series. This series is different from the electromotive series in that it not only shows the tendency of the several metals to corrode in a solution, but it also predicts, to a large extent, the susceptibility of metals or alloys to create galvanic corrosion should they be connected together and exposed to the same solution. Metals far apart in the series may create corrosion of the one higher in the series with protection of the one lower in the series. Depending upon the corrosive, metals in the same group may change positions within the group, but seldom from one group to another.

Nickel, the principal constituent of Monel, possesses the ability to acquire a protective oxide film in many environments, which accounts for its greater resistance to corrosion than can be accounted for by its inherent resistance to chemical solution. While nickel possesses this property to a much less degree than chromium, nevertheless, this effect gives Monel a greater degree of resistance to oxidizing conditions than is possessed by copper. Conversely, copper gives Monel a greater amount of resistance to reducing conditions than is possessed by nickel The net result is usually a greater resistance of Monel to most environments than either of its two chief constituents.

The corrosion rates of metals or alloys which do not evolve hydrogen from a solution having a high hydrogen-ion concentration, such as moderately strong sulfuric acid solutions, are dependent largely upon the oxygen content

TABLE 4

Electromotive Series of Elements and Galvanic Series as Indicated by Experience

Electromotive Series[1]		*Galvanic Series*[2]
Metal	*Potential In Volts*	
Potassium	—2.924	Magnesium
Calcium	—2.76	Aluminum
Sodium	—2.714	Duralumin
Magnesium	—2.40*	Zinc
Aluminum	—1.7	Cadmium
Manganese	—1.1*	Iron
Zinc	—0.76	Chromium-Iron (Active)
Chromium	—0.56	Chromium-Nickel-Iron (Active)
Iron	—0.44	Lead Tin Solder
Cadmium	—0.40	Tin
Nickel	—0.23	Lead
Tin	—0.14	Nickel
Lead	—0.12	Brasses
Hydrogen	0.000	Bronzes
Copper	+0.344	Monel
Silver	+0.80	Copper
Mercury	+0.86*	Chromium-Iron (Passive)
Gold	+1.5*	Chromium-Nickel-Iron (Passive)
		Silver Solder
		Silver
		Platinum
		Gold

[1]International Critical Tables, Vol. 6, Page 332.
*Reference Book of Inorganic Chemistry, p. 367-8, Latimer & Hildebrand.
[2]Data Book, Monel and Rolled Nickel, Page C-1, International Nickel Company, Inc.

of the solution. However, the effect of air, or oxygen, may be complicated by the development of passive films that retard corrosion rather than accelerate it. The behavior of Monel and austentic stainless steels in aerated sulfuric acid are typical examples of this phenomenon. Laboratory data in 5 per cent sulfuric acid at room temperature, the oxidizing power of which was varied by saturating the acid with different mixtures of oxygen and nitrogen, showed that with zero oxygen the corrosion rate of Monel was practically zero, while stainless steel was attacked at a high rate. In acid with 100 per cent oxygen saturation, the reverse was true. At an oxygen concentration equivalent to that of air-saturated acid, the behavior of stainless steel was very erratic, representing a response to critical oxidizing power. Minor variations in oxygen content near the saturation value for air showed wide differences in the corrosion rate of stainless steel, equal in some cases to the corrosion rate in air-free acid. This behavior is not apparent with Monel, which corroded at a uniform rate, higher than in oxygen-free acid, but much lower than in 100 per cent oxygen-saturated acid. It may be well to note at this point, that halides, for example, hydrochloric acid, are very active in breaking down passivity, and oxygen normally occurring in thoroughly aerated, dilute hydrochloric acid is generally insufficient to promote passivity of the 18-8 variety of stainless steels.

The steady increase in the corrosion of Monel with increasing oxygen concentration is by no means common only to Monel. Similar tests on such metals as copper, brasses, and iron, show increased rates of corrosion of even

greater magnitude than Monel. It is significant to note that air-free or nearly air-free acid is practically non-corrosive to Monel, and this feature persists in concentrations of sulfuric acid as high as 80 per cent by weight.

The above discussed effect of oxygen suggests the great importance of control of this constituent in carrying out laboratory tests, or in interpreting the results of such tests. Since all metals and alloys do not respond alike to the effect of oxygen content of the corroding solution, it is necessary to control oxygen as nearly comparable as possible with the actual conditions of service. For this reason, it is decidedly better to conduct tests directly in the operating equipment, where it is unnecessary to provide for control of the several important factors influencing corrosion rates, such as oxygen concentration, temperature, rate of motion or agitation, and solution composition. Since all of these factors are interrelated, it has become more general practice to depend upon plant tests rather than on laboratory tests to supply corrosion information, and to form the basis for selection of proper materials for the specific job.

Fortunately, tests in operating plant equipment are, in most instances, readily carried out. To facilitate procedure, standard specimens and specimen holders similar to the one shown in Figure 1 are used. The principal features of such a device provide for inclusion of a number of metals and alloys in the same test, insulation of the different specimens from each other, and protection of the specimens from mechanical damage. The specimens are weighed before and after the test, the weight losses being used as the basis for calculation of the corrosion rates into useful units. Weight loss data can be supplemented by careful inspection of the specimens for local attack, pitting, or intercrystalline corrosion.

An indication of the corrosion resistance of Monel to several chemicals often encountered in the textile industry is evidenced by the data in Table 5. It may be noted that Monel is practically completely resistant to concentrated caustic soda, salt, and unaerated acid solutions, and possesses useful resistance to hydrochloric, sulfuric, and hydrofluoric acid solutions. Experience shows that Monel is superior to all other commercially available wrought materials in resistance to dilute sulfuric and hydrochloric acids. Monel is not resistant to nitric acid and other highly oxidizing acids, such as chromic acid. Monel is also not highly resistant to sulfurous acid.

The very high resistance of Monel to corrosion by caustic alkalies enables its use in contact with such alkaline solutions as are used for mercerizing, the applications of vat colors, sulfur colors, and viscose solutions. The nickel content of Monel is sufficiently high to give it resistance to sodium sulfide used in sulfur colors, in contrast with the lack of resistance of high copper alloys. The resistance of Monel to this chemical is well demonstrated by results of corrosion tests in a 50 per cent solution of sodium sulfide at 320° F., which showed Monel to corrode at a rate of only 0.0013 inch penetration per year.

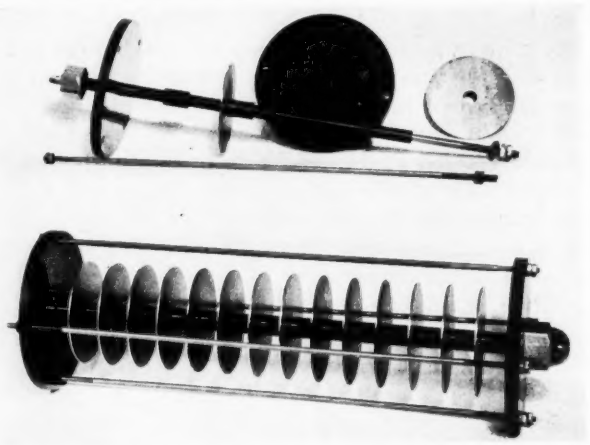


Fig. 1—Spool Type Specimen Holder Used for Making Corrosion Tests in Plant Equipment.

TABLE 5

The Resistance of Monel to Corrosion by Several Corroding Media

Media	*Corrosion Rate Mg. loss/sq. dm./day*
Caustic Soda, 30-50%, 179° F. ave. (test in evaporator)	1
Saturated Sodium Chloride Solution, 180° F., no aeration	1
Sodium Chloride, 3% NaCl, 30° C., air saturated, low velocity	6
Pure Citric Acid Solution, 60-62%, 130-150° F., no aeration	3
Sulfuric Acid, 25%, 60-80° F., no aeration, low velocity	8
Sulfuric Acid, 10%, 60-80° F., no aeration, low velocity	12
Sulfuric Acid, 10%, 60-80° F., air saturated, low velocity	215
Hydrochloric Acid, 3.6%, 60-80° F., no aeration, low velocity	35
Hydrochloric Acid, 3.6%, 60-80° F., air saturated, low velocity	524
Hydrochloric Acid Pickle, 10% HCl, 70-90° F., no aeration	135
Frosting Solution, 60% HF, 130-140° F., air saturated, low velocity	51
Concentrated Nitric Acid	Very high

Inconel, an alloy containing approximately 80 per cent nickel, 14 per cent chromium, balance iron, is highly resistant to corrosion by the chemicals occurring in textile processing. It is particularly useful in diazotizing developed colors, where Monel may be corroded fairly rapidly by the nitrous acid present. Inconel is practically free from attack by even the most concentrated solutions encountered in actual plant operation. Some data on Inconel, Monel, and nickel in typical diazotizing solutions are given in Table 6. It may be noted that Inconel is completely resistant to the conditions in Solution B, which is comparable with most practical operations. Some recent tests made in a dye tank involving diazotizing and stripping in the same tank, showed Inconel to corrode at

TABLE 6

Results of Laboratory Corrosion Tests in Diazotizing Solutions

Duration of Tests..... 30 min.
Aeration of Solutions..... Unaerated
Movement of Specimens..... 16 ft. per minute
Temperature ..... 45° F.
Composition of Solutions:.....

	Solution A	*Solution B*
Sodium Nitrite.....	6 grams	1 gram
Concentrated Hydrochloric Acid....	15 cc.	2.5 cc.
Water.....	1 liter	1 liter

Results

Metal	*Corrosion Rate in Mg./sq. dm./hour*	
	Solution A	*Solution B*
Inconel	3	0
Monel	1812	170
Nickel	734	..

TABLE 7

Results of Plant Corrosion Tests in a Print Ager Handling Rapidogen Colors

The specimens were exposed on spool type specimen holders to both vapors and condensate in the print ager.

Duration of Test:
180 hours in vapors
300 hours in condensate

Chemicals Used:
Mixture of 6 parts 56% acetic acid and 1 part 90% formic acid added to ager at rate of 12 quarts per hour.

Results

Metal	*Corrosion Rates In Mg. loss/sq. dm./24 hours*		*In Inch Penetration per 2000 hours*	
	In Vapors	*In Condensate*	*In Vapors*	*In Condensate*
Inconel	45	87	0.0017	0.0032
Monel	49	48	0.0018	0.0018
Nickel	67	66	0.0025	0.0025
Mild Steel	2260	+13550*	0.108	0.64

*Minimum rate since the specimens of steel were destroyed during the first 180 hours of test.

TABLE 8

Results of Laboratory Corrosion Tests in Rayon Desulfurizing Solution

Duration of Test..... 20 hours
Aeration of Solution..... Saturated with Hydrogen Sulfide
Movement of Specimens..... None
Temperature..... 147° F.
Composition of Solution:
Sodium Sulfide..... 1.5%
Sodium Carbonate..... 0.1%

Results

Metal	*Corrosion Rates In Mg. loss/sq. dm./24 hours*		*In Inch Penetration per 2000 hours*	
	Specimens Immersed	*Specimens in Vapors*	*Specimens Immersed*	*Specimens in Vapors*
Inconel	1	6	0.00004	0.0002
Monel	151	25	0.006	0.0009
Nickel	54	23	0.002	0.0009

a rate of only 0.005 milligrams loss per square decimeter per hour. This rate of corrosion is equivalent to about 0.00002 inch penetration per year, a very low rate indeed.

Due to the presence of nitrous acid in diazotizing, it might be expected that Monel would be corroded appreciably in such solutions. The conditions of the test in Table 6 are especially severe, since no dyestuff was present to react with part of the nitrous acid and thus reduce, at least partially, the extreme corrosiveness of the fresh solutions. The actual behavior of Monel in the presence of diazotizing reactions is dependent upon the ratio of the volume of the dye-bath and the weight of the goods being treated. This is due to the fact that the concentration of the chemicals is based upon the weight of the goods. More corrosion occurs in a "short" bath than in a "long" bath; that is, greater corrosion can be expected in jigs than in other types of dyeing machines where a greater volume of dye solution is used, such as in the several types of skein and reel-type piece goods machines. For example, tests on Monel in a Hussong-type diazotizing machine showed a corrosion rate of only 0.002 inch penetration per year, used continuously 8 hours per day, for dyeing with developed colors.

A study of the behavior of Monel in contact with diazotizing solutions has lead to the following suggestions for keeping corrosion to a minimum:

1. Since the active corroding agent is the nitrous acid in excess of that required for the diazotizing reaction, the quantity of chemicals used should be kept at a minimum to avoid excess nitrous acid.

2. Decreasing the concentration of nitrous acid, by running as "long" a bath as possible, can be expected to reduce the amount of corrosion. Since the capacity of the dyeing machine limits this to some extent, it is advisable to keep the diazotizing bath as large as is consistent with good practice.

3. Sulfuric acid should be used rather than hydrochloric acid in the diazotizing bath.

4. The diazo reaction should be carried out at as low a temperature as possible.

5. Some attempts should be made to control the amount of chemicals used in the diazo reaction so that the amount of nitrous acid produced and available for the diazo reaction should be as near as possible to the theoretical amount required by the dyestuff; that is, avoiding any excess which would be available for corrosion.

6. Monel dye machines should not be used for continuous dyeing with developed colors, but an occasional use should present no trouble, especially where the diazotizing is controlled along the suggested lines.

In the construction of agers for rapidogen colors, the metal must withstand the action of hot fumes from acetic or formic acid, or a mixture of the two. Data obtained in an operating ager are given in Table 7. The extreme corrosiveness of these fumes is indicated by the results on steel of plant tests in an operating ager employing a mixture of acetic and formic acids. Corrosion resistance of a high order is required to resist these fumes. More recently in tests in an ager employing only acetic acid, Monel was corroded at a rate of about 0.002 inch penetration per 2,000 hours (0.009 inch penetration per year). Monel apparently provides adequate resistance to corrosion in both types of aging operations. It is of further significance that the specimens of Monel in these tests showed no evidence of local attack or pitting.

TABLE 9

Results of Plant Corrosion Tests in Rayon Desulfurizing Process

The specimens were exposed on a spool type specimen holder to fumes from desulfurizing solutions.
Duration of Test.....100 days

Metal	Corrosion Rates: In Mg. loss/ sq .dm./ 24 hours	Corrosion Rates: In Inch Penetration per Year (8760 hr.)
Inconel	1.5	0.00025
Monel	3.3	0.00055
Nickel	1.0	0.00017

TABLE 10

Results of Plant Corrosion Tests in Rotary Skein Dyeing Machine

Specimens were mounted on a spool type specimen holder which was placed on the bottom of the dye tank.
Duration of Test:
24 days during which 47 lots were dyed for an average period of 5 hours each.
The types of dyeing included regular acid, chrome acid (top chrome) and Neolan colors on wool skeins using sulfuric, formic and acetic acids.

Results

Metal	Corrosion Rates: In Mg. loss/sq. dm./ 24 hours			In Inch Penetration per 2000 hours		
	1st 17 lots	2nd 30 lots	Total 47 lots	1st 17 lots	2nd 30 lots	Total 47 lots
Inconel	5	0	2	0.0002	0.0000	0.00007
Monel	62	82	74	0.002	0.003	0.003
Nickel	187	106	133	0.007	0.004	0.005

TABLE 11

Results of Laboratory Corrosion Tests During Process of Experimental Dyeing of Wool with Sulfuric Acid

Duration of Test:
About 24 hours.
During the test the solution was agitated and aerated by movement of the cloth being dyed.

Results

Metal	Corrosion Rate: In Mg. loss/ sq. dm./ 24 hours	In Inch Penetration per 2000 hours
Inconel	15	0.0005
Monel	10	0.0004
Nickel	69	0.0025

TABLE 12

Results of Corrosion Tests in Acetic Acid-Sodium Dichromate Solution as Used in Wool Dyeing

Temperature: Boiling under reflux.
Duration of Test: 3 days.
Aeration: Both fully aerated and unaerated as indicated.
Movement of Specimens: None.
Composition of Solution:

Glauber's Salt	8 grams
28% Acetic Acid	2 grams
Sodium Dichromate	0.6 gram
Water	1000 cc.

Metal	Corrosion Rates: In Mg. loss/sq. dm./ 24 hours		In Inch Penetration per 2000 hours	
	Fully Aerated	Unaerated	Fully Aerated	Unaerated
Inconel	0.0	0.6	0.00000	0.00002
Monel	0.8	2.4	0.00003	0.00009
Nickel	2.2	3.7	0.00008	0.00014

Other plant and laboratory tests on dyeing and processing of textiles are given in Tables 8, 9, 10, 11 and 12. The data indicate the high resistance of Monel, nickel, and Inconel to various operations occurring in the dyehouse and manufacturing plant.

The data cited refer to those processes where corrosion is most severe. In view of the mild corrosive nature of solutions used with direct colors, and the practically complete resistance of Monel to corrosion by sodium chloride and sodium sulfate solutions, Monel can be used, and is used very extensively, for equipment handling direct colors as applied to cotton, silk, and rayon. Another wide use of Monel under moderately corrosive conditions is in thread-moistening equipment on hosiery knitting machines.

An important phase of textile processing is bleaching, which may be accomplished by the use of either chlorine compounds or hydrogen peroxide. It is well known that solutions containing free chlorine are about the most corrosive that metals are called upon to withstand. In fact, noble metals like gold and silver are not immune to attack. Monel, like most commercially available metals, is corroded by hypochlorite bleaching compounds as used in the textile industry. Experience and tests have shown that if the concentration of available chlorine is under 3 grams per liter, the rate of attack is not high. This limit for Monel is safely within the customary amounts necessary to accomplish efficient bleaching of practically all textiles. Monel is not recommended for continuous contact with bleaching solutions, although it is being used with complete satisfaction for cyclic operations in which bleaching, rinsing, and souring, are performed in the same machine. Monel should not be used for a container for chlorine solutions in processes where the goods are moved from tank to tank for the bleaching, rinsing, and souring operations, and where the bleaching solution is kept up to strength by periodic additions of stock chlorine solutions. It should be noted, however, that Monel can be used in this method of operation for reels and other carrying devices which are in contact with the bleach solution for relatively short periods of time, and are in contact with the rinsing and souring operation as well. Monel should not be used for containers handling concentrated stock bleaching solutions.

Experimental data have indicated that sodium silicate acts as a powerful inhibitor of corrosion when added to a hypochlorite bleaching bath. Concentrations of as little as 0.05 to 0.1 cubic centimeter of 1.4 specific gravity solution to 1 liter of bleach solution are effective in reducing the corrosion of Monel to practically zero.

Monel has been found by experience to be serviceable for equipment in which cotton, wool, or silk, are bleached in alkaline solutions of hydrogen peroxide. Independent tests from several sources, including a manufacturer of hydrogen peroxide, have shown that Monel has a negligible effect in catalyzing the decomposition of hydrogen peroxide solutions. If hydrogen peroxide is made by the interaction of sodium peroxide and sulfuric acid, rather

TABLE 13

Results of Plant Corrosion Tests in Oil Sulfonators

Specimens were mounted on spool type specimen holders.

Tests were made in three different plants in typical sulfonators operating with the usual quantities of sulfuric acid and several types of oils.

Results

Corrosion Rates—Inch Penetration per 100 Batches

Metal	Plant A	Plant A	Plant B	Plant C
	Neats Foot Oil	Cod Liver Oil	Tallow, Red Oil & Olive Oil	Castor Oil & Olive Oil
Monel	0.0016	0.0005	0.0005	0.0008
Nickel	0.0014	0.0011	0.0019	0.0010
Lead	0.0044	0.0057	0.012	0.0031

TABLE 14

Miscellaneous Corrosion Data on Ni-Resist and Unalloyed Cast Irons in Various Media

Tests at atmospheric temperature, except where otherwise noted.

Corrosive Media	Corrosion Rate In Mg. loss/sq. dm./Day	
	Ni-Resist	Unalloyed Cast Iron
Acetic Acid, 33%	17.0	840
Boracic Acid, 10%	7.7	57.4
Citric Acid, 5%	9.3	1,492
Formic Acid	13.9	138
Hydrochloric Acid, 1% Unagitated and Unaerated	32.5	1,007
Hydrochloric Acid, 5% Unagitated and Unaerated	54.2	3,360
Hydrochloric Acid, 20% Unagitated and Unaerated	62.0	11,180
Hydrochloric Acid, 5% Aerated	507	26,665
Hydrochloric Acid, 10% Aerated	598	29,475
Hydrochloric Acid, 20% Aerated	1,111	33,270
Nitric Acid, 1%	620	697
Nitric Acid, 5%	4,060	4,680
Nitric Acid, 20%	7,830	10,092
Oxalic Acid, 5%	6.2	55.8
Phosphoric Acid, 50%	26.4	4,650
Sulfuric Acid, 1% Unagitated and Unaerated	26.4	1,642
Sulfuric Acid, 5% Unagitated and Unaerated	37.2	6,880
Sulfuric Acid, 20% Unagitated and Unaerated	41.8	13,720
Sulfuric Acid, 5% Aerated	350	30,000
Sulfurous Acid	240	1,032
Tartaric Acid, 5%	10.8	1,040
Vinegar	4.6	104
Acetone	1.5	4.6
Aluminum Sulfate, 5%	20.0	96.0
Ammonium Chloride, 5%	10.8	35.6
Ammonium Nitrate, 5%	51.2	163
Ammonium Sulfate, 10%	9.3	32.6
Ammonium Sulfate, plus 5% Sulfuric Acid	26.3	11,160
Carbon Tetrachloride	1.5	3.0
Copper Chloride, 10%	1,394	8,030
Ferric Chloride, 5%	667	1,038
Ferric Sulfate (conc.)	17,000	32,000
Hydrogen Peroxide	6.2	9.3
Magnesium Chloride, 10%	7.7	18.6
Magnesium Sulfate, 10%	3.1	14.0
Potassium Alum, 10%	15.5	372
Sodium Chloride, 3%	50	190
Sodium Hypochlorite	223	688
Sodium Sulfite, 5%	1.5	1.5
Sodium Sulfite, 10%	3.1	6.2
Atmosphere, 30 days	9.5	59.7
Atmosphere, 90 days	7.9	63.5
Atmosphere, 1½ years	3.5	35.0
Bad Boiler Water, 95° C.	110	660
Fermented Molasses, Solution, 12½%	10	360
Water Spray, Vertical	6.6	207
Water Spray, Horizontal	17.6	244

than bought as such, the mixing should not be done in Monel equipment, since, when peroxide is added to the acid, a highly oxidizing acid mixture results, and this mixture may be quite corrosive to Monel. The mixing is best accomplished in a non-metallic vessel and the neutral solution added to the already alkaline bath in the Monel machine.

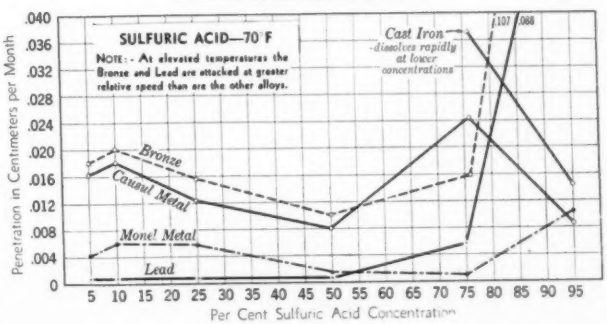
It is significant to point out that nickel is highly resistant to peroxide bleaching operations, and its availability in the form of nickel clad steel makes it an economical material for the construction of heavy bleaching equipment, such as kiers and large tanks.

While sulfonated oils, used extensively in textile processing, usually are manufactured independently of the textile plant, the textile chemist is concerned about the quality of the product which he will use in his process. Since Monel is outstanding in resistance to sulfuric acid, it is not surprising that it is also highly resistant to corrosion by the sulfonation reaction as indicated by the corrosion data in Table 13. It may be noted that the data in this table are stated in inch penetration per 100 batches, which enables direct calculation of the life of the equipment relative to number of batches processed. Monel is being used for linings in sulfonators, and for cooling coils, and reports show that the quality of oil produced is equal to that produced in glass equipment.

Frequently, applications in the textile industry, as well as other chemical industries, call for a moderately priced cast material highly resistant to corrosion. Monel can be alloyed with cast iron, and when the total alloy content is about 20 per cent, an austenitic cast iron is produced which has excellent resistance to corrosion by many media. This alloy is known as Ni-Resist and, while relatively new, it has found applications amounting to some millions of pounds per year.

Some data on Causul Metal (an alloy very similar to Ni-Resist), Monel, and bronze, in sulfuric acid, are compared in Figure 2. The Ni-Resist type of cast iron compares favorably with bronze in corrosion resistance, and, in fact, is superior to bronze at the higher concentration of acid. Additional data comparing Ni-Resist and unalloyed cast iron in numerous corroding media are given

Fig. 2—Corrosion of Causul Metal (Ni-Resist), Monel, Bronze and Lead in Sulfuric Acid.



in Table 14. The general superiority of Ni-Resist over ordinary cast iron is quite evident, particularly in strong acids and acid salts.

These data and specific applications referred to are only a small portion of those on record. Constant need of the textile mill operators for new and more efficient equipment will lead to a still wider adoption of corrosion resisting metals and alloys. The producers of metals are grateful for the cooperation of the textile chemist in assisting them in the allocation of the proper metals to the proper places.

APPLICANTS FOR MEMBERSHIP

Active

William Lloyd Fickert—Foreman Dyer, Interstate Hosiery and Victor Silk Hosiery Cos., Lansdale and New Britain, Pa. Sponsors: B. K. Archer, E. G. Haack.

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Student

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ONE HUNDRED AND FOURTH MEETING OF THE RESEARCH COMMITTEE

THE 104th meeting of the Research Committee followed the Council meeting in Boston on Friday afternoon, February 5, 1937. Present were Chairman Louis O. Olney, presiding, K. H. Barnard, J. R. Bonner, W. H. Cady, H. M. Chase, Hugh Christison, C. Z. Draves, W. C. Durfee, H. F. Herrmann, A. E. Hirst, Hans Meyer, R. M. Ritter, Ben Verity, and H. C. Chapin, Secretary.

There was received from the American Society of Mechanical Engineers an outline of plans and a request for papers for the National Rayon Conference in Washington on May 14 and 15, at which L. A. Olney and B. L. Hathorne are to represent the Association.

With reference to the Year Book it was voted that the nomenclature, spelling and abbreviations of the American Chemical Society be adopted, except for a few terms peculiar to the textile industry. Consideration was given to a letter from W. D. Appel suggesting various revisions. It was voted that well defined tentative test methods, as well as official methods, be printed in a section apart from the committee reports. It was voted that "Analytical Methods for a Textile Laboratory" be again revised and included in the next book, and that reprints of this section from the last book be advertised for sale at $0.75 per copy postpaid. It was voted that the reports of the Sulfonated Oil Manufacturers' Association be listed.

Mr. Christison reported for the Committee on Determination of Extraneous Matter in Wool. Plans for the Mercerizing Research and the Research on Chemistry of the Cellulosic Fibers were discussed. In reply to the suggestion that the Association develop abrasion tests, Mr. Christison advocated that the Association specialize on chemical tests, leaving mechanical tests for specialization by others. Extension of committee work on shrinkage to cover materials other than cotton was discussed. Mr. Barnard reported work on Crease Resistance tests was progressing at the National Bureau of Standards.

Mr. Cady read a report by Mr. Ariente, Mr. Verity and himself on "Safe Oil Removers." This was prepared by request of the National Association of Finishers of Textile Materials. In it are defined the character of safe oil removers, conditions of use, responsibilities and methods of setting disputes. Certain oil removers are listed as safe. It was voted that this be published in the American Dyestuff Reporter as a tentative report, subject to criticism and possible revision.

Mr. Durfee showed samples of Crock-Meter tests illustrating the degree to which goods might crock and still be acceptable. In describing the crocking test two strokes were defined as equivalent to one revolution of the crank. Mr. Christison again advocated abolishing the term "crocking" as ambiguous, and substituting the terms "rubbing" and "bleeding."

Respectfully submitted, H. C. CHAPIN, *Secretary*.

MAY MEETING, NORTHERN NEW ENGLAND SECTION

THE May meeting of the Northern New England Section will be held in Andover, Mass., instead of Boston on Friday evening, May 7th. The meeting place will probably be the Andover Country Club as a large attendance is anticipated. A special program that should appeal to everyone has been carefully worked out. It will consist of two things.

1. A sound picture entitled "Wonder World of Chemistry" through the courtesy of the DuPont Company. This covers many of the products of this company as well as their dyestuffs in an interesting and non-technical manner and has aroused much favorable comment both as a picture and for the music accompanying it.

2. A free-for-all forum and question box period which will have to be both seen and heard to be appreciated. As no notes will be taken and no report made on this part of the meeting, no questions are barred and all are to be answered.

K. H. BARNARD, *Program Chairman.*

REPORT, NORTH CAROLINA STATE COLLEGE STUDENT SECTION

THE Section had as its speaker in the week of March 8 former student A. E. Shumate, who is now at Leaksville-Spray.

Mr. Shumate spoke on several problems that he has had which were of interest to the students. He stayed with us a full day and gave some very interesting talks.

We want to thank him for the time that he spent with us. We would like to have more speakers this term.

JAMES W. FURR, *Secretary.*

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary or the American Dyestuff Reporter any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-1

Education—B.T.C., Lowell Textile Institute.

Experience—Two years as chief chemist in cotton mill. Experienced on direct, vats, naphthols, sulfur, basic and developed colors. Two years' experience in protein, fat fiber and mineral control in grains and animal feedstuffs. Age 28.

A-B-1

Education—Graduate chemist and colorist from a leading textile institute. Speaks French fluently. High standing at school. Awarded 1st prize in chemistry. Member of honor society.

Experience—Knowledge of most processes of textile manufacturing and some experience in woolen and worsted piece and stock dyeing and color matching. Presently employed in other department but wishes to get into laboratory or dyehouse.

A-B-5

Education—Graduate of the University of Lausanne, Switzerland. Doctor's degree in Chemistry. Knowledge of French and German.

Experience—Eleven years with large bleaching, dyeing, printing and finishing plant as assistant Chemist and then Chemist in charge of the Laboratory. Experience in dyeing and printing cotton and rayon fabrics; research and analytical work. Woman.

A-B-7

Education—Evening school in textile dyeing.

Experience—2 years laboratory in dyehouse; 9 years dyer and foreman on hosiery, ribbons and rayon; 2 years assistant to superintendent. Can handle help efficiently. Desires position as supervisor or demonstrator of dyestuffs. Age 30; married. Prefers vicinity of New York.

A-B-C-1

Education—B. S. in Chemistry, Massachusetts Institute of Technology.

Experience—7 years with a prominent worsted mill as assistant chief chemist, chief chemist, and superintendent of dyeing and wet finishing. Thoroughly familiar with chemical problems of worsted industry. Age 33; single. Location unimportant.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).

Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-C-3

Education—Graduate, Chemistry and Dyeing Course, Lowell Textile Institute, 1934.

Experience—Has experience as chemist; dyer of union knit goods (cotton and woolen); experienced bleacher on both. Has handled Tube-Tex processing on cotton and rayons. Single; will go anywhere.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following: celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-4

Experience—Foreman dyer in charge of ribbon dyeing for 20 years. Experienced on silk, cotton, rayon, acetate yarn. Age 41; will go anywhere.

B-F-1

Experience—As executive had charge of the dyeing of ribbons and piece goods for 6 years; spun silk yarn, fast and resisted dyeing for 8 years; hosiery for 12 years. Has been quite successful in all three of these mills. Age 50 married. Will go anywhere.

MEETING, LOWELL TEXTILE INSTITUTE STUDENT SECTION

THE Lowell Textile Institute Student Section of the A.A.T.C.C. held one of its regular meetings on Friday, March 19, 1937, at 3:15 P. M. Mr. Eric Laurin gave an instructive talk on "Dyeing and Finishing of Acetate and Viscose Rayons." Attendance was about fifty.

Respectfully submitted, H. FRANCIS CARROLL, *Secretary*.

ANNUAL MEETING AND CONVENTION

American Association of Textile Chemists and Colorists
Bellevue-Stratford Hotel, Philadelphia, Pa.
December 3 and 4, 1937

TEXTILE CHEMICAL SPECIALTIES

AGAIN the American Association of Textile Chemists and Colorists is preparing a list of textile chemical specialties for publication in our Year Book. It is the purpose of the Association not only to make conveniently available for its members a list of the chemical products which can be purchased in the American market for the processing of textile materials, but also to disclose the chemical nature of those products so that the chemist can use them with greater understanding. Since the list is published in the interest of our members for their information, there is no charge to the manufacturer or importer for the listing of products.

The policy expressed in the original resolution of the Council authorizing this department has been followed again: namely, that "The list of products for textile processing shall be limited to homogeneous substances for which the chemical formula or complete qualitative composition or method of manufacture is given by the seller." Generally speaking, only products with proprietary names or specific textile uses have been included. But even then, many products which are widely used in the textile industry at great economy and with much advantage, such as sulfonated oils, soaps and many other products, have not been included because they are so common that listing would have no particular instructional value and their great number would make the list too long. Furthermore, there are many meritorious products on the market with secret compositions of which the disclosure would invite unfair competition since they can not be protected by patent. For these reasons, the omission of a product from the list must not, under any circumstances, be taken as a reflection upon its usefulness in a textile mill.

The chemist using the tables must remember that the information given concerning the various specialties with respect to uses and composition is obtained mostly from the firms offering them for sale and cannot be vouched for by the committee. The value of a textile specialty for a given purpose must be determined on its own merits since the committee merely repeats information which it feels reasonably certain is true. The listing of a product for a specific purpose implies no guarantee on our part of the practical usefulness of the product for the purpose indicated.

The committee earnestly solicits the cooperation of all manufacturers and importers for the improvement of this authentic list of chemical specialties available in America for the processing of textile materials. Those who have not participated thus far in the work are invited to send the necessary information at once to the Chairman for inclusion in the next Year Book. This information should be tabulated as follows:

1. Firm abbreviation, limited to four letters and conforming to, or not interfering with, the abbreviations used in the Tabulation of American Dyes.
2. Proprietary or trade name under which the chemical specialty is sold.
3. Principal uses, very briefly.
4. Chemical nature:
   (a) Systematic chemical name or chemical formula, if an essentially pure substance; or
   (b) Complete qualitative composition, if a mixture; or
   (c) Method of manufacture, very briefly, with names of raw materials.

CARL Z. DRAVES, *Year Book Committee*.
273 Converse Street, Longmeadow, Mass.

AMERICAN
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THE WAGNER ACT DECISIONS

IGNORING for a moment the direct results of the Supreme Court's decisions on the Wagner Labor Relations Act, the decisions have been variously interpreted as a victory for the court policies of the Administration or as a vindication of the present Supreme Court set-up. However, does it not appear reasonable to assume that the Administration can ask no more of a Supreme Court than the position which a majority has now defined in regard to the relative positions of State and National governments? The present decisions, together with the reversal of the Court's decision a short while ago in respect to the state minimum wage law, have affirmed the powers of the States to deal with such social questions as the payment of lower wages than are warranted under certain living conditions and further have also affirmed the powers of Congress to deal with other social questions provided that they actually do affect interstate commerce and are not so far removed from it as to be beyond the power of the National government. If the present Administration is not satisfied with a Court that recognizes clearly the individual and distinct powers of State and National governments, then its only alternative is to ask for a complete change of our present governmental set-ups.

In regard to the direct results of the decisions on the Wagner Act, there is an opportunity presented to the Administration, now that the Act has been upheld in a number of cases, to revise the Act in order to make it more workable and fair to all. As a piece of legislation the Wagner Act is overwhelmingly partial and in the problem of industrial relations it sacrifices the good-will of the employers. It recognizes only unfair practices which may be attributed to the employer but ignores completely any similar practices on the part of labor. The provision which gives sole bargaining rights to any majority group is unfair to other laborers and undemocratic in principle.

What apparently is needed now is legislation which would give to the employing groups the same rights of protection as the Wagner Act gives to labor. It is essential that the rights of employers be defined and protected if we are to have a workable national industrial policy. It has been suggested that such legislation should outlaw sit-down strikes (the Wagner Act should automatically exclude such tactics), should protect the community against sympathetic and general strikes, should prevent the coercion of unorganized employes who wish to remain so and should fix legal responsibility upon labor organizations through incorporation or licensing and make their contracts binding upon them. Out of the jumble of legislation and present-day thoughts and trends perhaps we shall eventually evolve a policy that will be equally beneficial to employe and employer.

KNITTING ARTS EXHIBITION

APPROXIMATELY 175 exhibitors will display their wares at the thirty-third annual Knitting Arts Exhibition to be held this week at the Commercial Museum in Philadelphia. The exhibition held last year established a new high record in point of size and the present exhibition will have about forty more booths than last year. Advance indications are that attendance this year will also set a new record inasmuch as improved conditions in the industry, greater interest in new equipment, material and processes, together with the annual meetings of hosiery and underwear manufacturers are expected to draw an unusually large crowd to Philadelphia this week.

In point of decoration, further improvements have been made to the physical layout of the exhibition this year. New signs for exhibitors, a new paint job on the hall itself and a direct entrance to the exhibition instead of through the Commercial Museum are all new improvements. The plan which was put into effect last year of furnishing knitting mill superintendents, executives and foremen with an identifying label will be continued.

The exhibition is sponsored by the National Association of Hosiery Manufacturers and the Underwear Institute who will hold their annual meetings on Wednesday and Thursday, respectively.

As usual there are many exhibits which will appeal to dyers, chemists and finishers who are primarily interested in the wet processing of hosiery and other knit goods. New equipment, materials and processes are being shown for use in the dyeing and finishing of these fabrics. For the convenience of those readers who are attending the show we have listed on other pages of this issue a number of exhibits which we believe will be of particular interest to them. We again urge all who possibly can to attend the show.

Flexease Test for Yarns

EDWARD KENNEDY*

● **Describing a new test for Determining the Flexibility of Yarn.**

FLEXEASE is the term given by the United States Testing Company to that quality or qualities of yarn commonly called the pliability or flexibility of yarns.

In nearly every operation in the mechanical handling of yarns, pliability and flexibility are desirable properties. In winding, spinning, twisting, knitting, weaving, warping, and crepeing, it is important that the yarn be pliable, that is, permit ready bending and twisting. In winding but slight pliability is required since a very slight curvature is needed. In twisting and spinning the yarn is twisted rapidly under high torque, so that torsion rather than bending is required. In knitting the yarn is laid across needles and loops are formed by the action of sinkers and dividers. This involves bending to sharp curvatures. In weaving, the warp yarns are crimped about the filling yarns by the action of heddles and reeds. In crepeing, the strain in lightly twisted filling threads is released by wetting with consequent drawing together of filling to produce a crepe fabric.

One of the purposes of soaking raw silk is to render the yarn more pliable. Raw silk yarns are naturally stiff due to the presence of sericin. Pliability is such an important property as to justify the development of soaking formulas and methods based upon this property in particular rather than upon concern for oil content or bath exhaustion. It was for this reason that considerable effort has been recently expended in developing a suitable pliability test for determining the Flexease of yarns.

It is also believed that a wide difference in the initial pliability of raw silk yarns exists and that such different yarns require different soaking treatments to produce a uniform product from all. One of the most serious defects in full-fashioned hosiery is sleaziness which is a crepey appearance due to the presence of distorted loops. This defect originates in knitting due to the stiffness or lack of pliability of thrown yarn. Usually this defect is not apparent in the greige goods directly after knitting but lies residual in the loop ready to appear during the boiling-off process. By soaking yarn to produce a desired Flexease it is expected that sleazy knitting may be eliminated.

The character and amount of sericin determines the Flexease of raw silk. It is believed that a soaking bath should have the property of penetrating and softening the sericin and thus render the yarn soft and pliable. If even penetration is not obtained, distorted loops will result in knitting.

APPARATUS DEVELOPED

The Flexease test herein described is new and has been invented and developed by the United States Testing Company, Inc.

In order to simulate the action of knitting, a test machine was made, using standard needle bar and sinker equipment, such as is used in actual knitting.

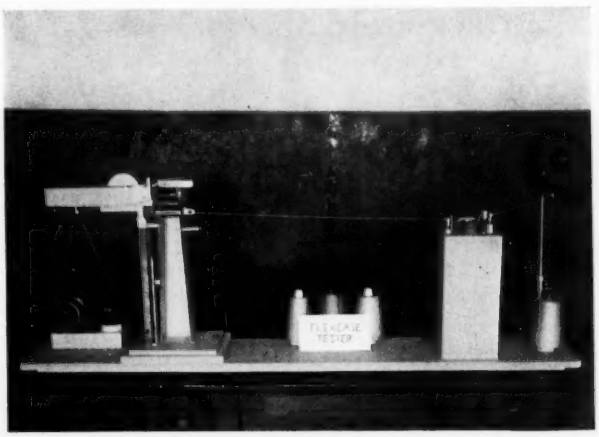
A special releasing mechanism was designed for dropping the sinkers one at a time as in knitting. The speed of travel of the releasing apparatus of the sinkers is so regulated mechanically that each sinker dropped at a uniform interval during the test. At the end of the test the releasing apparatus is easily reversed to its original starting position.

Each sinker upon release is propelled by a constant force or tension by means of spring steel. The 27 sinkers in the apparatus are under the same constant tension. The tension used can be adjusted to any desired amount by means of a special screw device.

Twenty-seven (27) sinkers are used and 27 loops are formed by the drop of the sinkers for each test. The average drop is taken in each test made.

The yarn is held under constant tension by a device which consists of a moveable weight moving vertically

The Flexease Tester



* United States Testing Company, Inc.

over an indicator scale. The movable weight for tension is designed so that one end of the test yarn is easily fastened and held in alinement with the center of the weight. The scale is calibrated in centimeters. A formula is derived based on the relation of the rise of the movable weight as indicated on the scale and the drop of the sinkers from which the average drop of the sinkers or length of loop formed is easily determined. The greater this value, the greater the Flexease.

PROCEDURE

The test yarn is placed in the apparatus and yarn is attached to the movable weight and adjusted by pulling on the yarn at the fastening clamp and so that it hangs freely with the weight at position zero. The clamp is then fastened securely. The apparatus is leveled so that the traveling weight is plumb.

The check holding the sliding bar stop is released and the bar then moves, releasing one sinker at a time. As each sinker is released it drops on the yarn and pushes it between the needles thus deflecting the silk from a straight line to form a series of loops. Each sinker as it forms a loop causes the movable weight to rise. The rise of the movable weight is recorded. The greater the travel or drop of each sinker the greater is the distance the weight travels upward or the greater the rise. In case some portions of the silk tested are more pliable than other parts, the drop of the sinker in that portion will be greater than that in the less pliable portion.

The movable weight acts as a tension on the silk yarn and remains constant throughout the test.

The distance the sinker drops and consequently the size of the loop formed depends on the force propelling the sinkers and the tension produced by the movable weight. The drop of the sinkers is a relative measure of the Flexease of the yarn.

MEASURE OF FLEXEASE

The term Flexease means the ability of the yarn to bend and is dependent upon the elasticity and diameter of the yarn. Under the impact force of the sinkers the yarn is bent, the fibers on the convex side of the neutral axis are elongated, those on the concave side are compressed. The sum of the moments of the internal stresses about the neutral axis are zero under static loading.

SCOPE OF FLEXEASE MACHINE

The pliability tests can be made on raw silk single ends or on any type of thrown silk or yarn.

The effect of different soaking treatments can be evaluated with this apparatus. The effect of oil concentration can be determined and the minimum and maximum limits determined.

This apparatus has shown that the addition of an alkali such as K_2CO_3, tends to increase the Flexease of the yarn when it is moistened as in knitting; that soap does not render the silk as pliable as does a soaking oil. The effect of different amounts of reagents such as K_2CO_3, glycerine, and other special products, can also be determined.

The tests for any particular treatment can be made on the conditioned yarn, and also after it has been passed through water or if desired, over a wick. Thus, the effect of wetting can be determined for varying proportions of different soaking reagents.

The Flexease of yarn is an important quality designation.

Progress in

Hosiery Dyeing and Finishing*

G. F. HARDCASTLE and W. A. EDWARDS

• An Article which presents the British View on the later Developments of Hosiery Dyeing and Finishing.

UP to the period just before the war the bulk of the hosiery was of the heavy type, the colors chiefly being black, navy, tan, etc., the underwear was made of either all wool (mostly of the heavier type), cotton and wool mixtures, including the so-called merino in the natural color—bleached but rarely dyed. Since then, changes in fashion, particularly in ladies' wear, have been responsible for the introduction of other kinds of hosiery having a smarter appearance, varying texture and more variety of color. In men's wear also the tendency has been much the same.

During this period the synthetic vat dyes were introduced which, when applied in a certain manner, to cotton chiefly, gave colors of exceptional fastness to light. While this property did not appeal so much to the hosiery dyer, it was found that a large number of these dyes were satisfactorily fast to bleaching and acid cross-dyeing. This enabled the manufacturer to introduce cotton yarns dyed with these colors into various classes of woolen hosiery. When

*The Textile Manufacturer (England).

these were subsequently dyed with acid colors they gave a large variety of pattern effects.

Another development was the introduction of the artificial fibers, chief of which was viscose rayon. In the earlier stages the use of this fiber was limited to effect threads, on account of the weakness of the material, especially when wet. Improvement in the manufacture of these fibers, partly overcoming this defect, enabled manufacturers to produce hosiery composed chiefly of artificial silk, with other fibers in the parts most subjected to strain and wear. A serious defect in artificial silk hose is the liability to "ladder", but this is being overcome by improved methods of knitting. Acetate artificial silk being different from other varieties, especially in dyeing properties, was some time before being adopted for hosiery. It was found to be very useful when mixed with cotton for the production of the so-called "Marl" effects where, owing to these different dyeing properties, the cotton could be dyed with selected colors and the acetate left undyed. The production of cuprammonium silk in very fine filaments has resulted in its more extensive use for hosiery. Apart from the use of the artificial materials in hose and half-hose, these fibers are now extensively used for the production of knitted fabrics and articles of underwear and outerwear.

While natural silk has been used for years in the British hosiery trade in the form of spun silk yarns, the successful production of fine gauge material of artificial silk has led to a great increase in the production of similar hosiery from the natural fiber. By knitting "in the gum," the liability of damaged fibers was reduced, and consequently the manufacture of natural fine gauge silk hosiery became a practical proposition.

On the introduction of these newer fibers (and in some cases modifications of the older fibers, such as mercerized cotton, etc.), and varying mixtures of these used in hosiery, the dyer has had to adopt newer methods of working. Running parallel with this has been the more intensive research into the dyeing and finishing processes leading to the introduction of newer types of dyestuffs and auxiliary products which assist the dyer in fulfilling the demands of the trade.

SCOURING OF KNITTED MATERIALS

Scouring is a most important process in dyeing and finishing and is almost entirely done by the "emulsification" method. Within recent years a large amount of work has been done to throw some light on the principles involved in this scouring process. As a result it is generally accepted that a good scouring agent must be capable of (a) thoroughly and quickly wetting out the material, (b) completely emulsifying grease, etc., and (c) stabilizing this emulsion of grease and dirt so that it is easily rinsed away from the material.

The oldest scouring agent is a good soap which fulfils all these conditions, and this agent is still the one mostly used for the purpose. The manufacture of soaps has improved considerably during the past thirty years or so, and the textile soaps of reputable makers today are very pure and reliable. Unfortunately soap has one serious defect: it is affected by hard water, and most waters are more or less hard. The soluble salts, chiefly of calcium and magnesium, which causes the hardness of water, react with soap forming insoluble salts of these metals. In this way much of the soap is wasted because these insoluble soaps have no detergent properties. Worse still they are very sticky substances which adhere to the material, causing trouble in dyeing, destroying the handle and dulling the brilliance of colors and whites. Many cases of patchy and uneven dyeing, of poorness of handle and dullness may be traced to the presence of these insoluble soaps.

This led to the introduction, about fifty years ago, of water softening by the addition of calculated amounts of lime and soda to the hard water, removing the precipitated calcium and magnesium compounds by settling and filtration. Many forms of apparatus have been devised for carrying out this process, the later ones being automatic in action. This method (lime-soda) does not remove the whole of the hardening salts, but within recent years, what is known as the "base exchange" method has been introduced, by means of which a water free from all hardening salts can be obtained by simple percolating through a bed of natural or artificial zeolite. Water from this type of softener still contains either equivalent quantities of neutral salts or bicarbonates, depending on whether the hardness is temporary or permanent. These do not interfere with many dyeing or finishing operations, except those where alkalinity is undesirable.

For many years chemists have been trying to produce substitutes for soap which would not be susceptible to hard water. The earliest of these were of the "Turkey Red" oil type made by the action of sulfuric acid on castor oil. These contained the sulfuric acid ester of ricinoleic acid as a sodium salt. Afterwards true sulfonates of ricinoleic acid were made and later sulfonated polyricinoleic acids. All these gave soluble calcium salts, and were not so much affected by hard water. While they could replace soap in softening and finishing processes they were of no use as detergents since their emulsifying, lathering and cleansing action was very poor. It was then discovered that the carboxyl group in these products was responsible for their low resistance to lime and their poor cleansing properties. By modifying this group new compounds were obtained which were very useful in many processes but still lacking in detergent properties. Next the alcohols corresponding to the fatty acids were obtained and treated with sulfuric acid. The sulfuric acid esters of these alcohols in the form of sodium salts are now commonly termed "sulfated fatty alcohols." These compounds are soluble in water, are neutral and do not readily form calcium salts, and where these are formed they are not sticky or greasy. Moreover, they are stated to have detergent properties and are stable in moderately acid or alkaline solution. When used along with soap it is claimed that they prevent the formation of lime soaps. Similar products are obtained from the alcohols corresponding to the unsaturated or oleic series of acids. Their solutions are practically neutral and have no felting action on wool. These compounds, sold

under different trade names, are finding increasing application for various purposes.

While on the subject of lime soaps we should mention a very important discovery made in America a few years ago. This was that a compound known as sodium hexametaphosphate had the remarkable property of reacting with calcium and magnesium salts and holding them in such a form that they cannot react with soap. Further that calcium soaps already formed are decomposed with the liberation of the original sodium soap and the formation of a lather again. This substance with a small addition of another phosphate has been placed on the market and is being used commercially. It slightly reduces the alkalinity of soap solutions and when used with soap should be mixed with a little mild alkali. One form is so adjusted by the makers. It has no detergent properties but can be used along with soap to prevent the formation of lime soaps or in the rinsing bath to remove any such soaps formed in scouring. It has no effect on fibers or colors and may be used in any process where lime soaps are liable to be formed.

During the past fifteen years or so a good deal of research has been done on the principles involved in the scouring of wool or woolen goods, with a view to more accurate control of the process and to ensure the best condition of the scoured material. The scouring process in the past was undoubtedly crude, and scouring agents not of the present day standards. Much knowledge was, of course, gained by practical experience. It has long been known that the addition of alkali assists the scouring value of soap, but for a long time there was no means of accurately controlling the alkalinity of a scouring liquor. In order to determine the exact intensity of alkalinity or acidity, there has developed during recent years a method of measuring the hydrogen ion concentration, or the pH value, of a solution. In the scale of pH values, 7 marks the neutral point or the value for pure water. The values upwards from 7 show increasing intensity of alkalinity, and downwards from 7 increasing intensity of acidity. These values can be determined accurately by delicate electrochemical apparatus which, however, is scarcely suitable for the works. But they can also be determined with sufficient accuracy for works' practice by using solutions of various indicator dyestuffs. Solutions suitable can be bought from chemical dealers and a chart of the colors and values supplied. In the case of scouring wool with soap and alkali, the normal detergent effect is about pH 10.7, but it is possible for some damaging effect on wool to occur at this point, and a liquor of a lower pH would be better from the point of view of luster finish and handle.

Usually the hosiery finisher combines the operation of scouring woolen goods with the "milling" or "fulling" process. In knitted material the object of this is to obtain a softer and fuller handle, and should not be taken beyond the point of felting, since this would destroy the elastic properties which are an essential feature of knitted fabrics. It is necessary, therefore, that the manufacturer should take the limitations of this process into account, according to the quality and type of fabric desired.

The machinery used in scouring and milling has undergone little alteration. The "dolly" or "tom-tom" machine and the rotary washer are still in use for hosiery and garments. For knitted fabrics of the heavy or coarse type the combined scouring or milling machine is still used. For botanies and fine fabrics, machines having light rollers are preferable. As the tendency in knitted fabrics is towards still lighter and more open structure, lighter machines will be more extensively used.

BLEACHING OF HOSIERY

The bleaching of woolen hosiery goods has been carried out since the earliest days of the industry by the sulfur stoving process, and this method is still in use. The material, well scoured and washed, is hung in a moist condition in a large chamber or stove. Sulfur is put in a suitable pot in one corner of the stove and ignited. The stove is closed and the material is left exposed to the action of the sulfur dioxide generated for several hours, usually overnight. The stove is then opened, thoroughly ventilated, and the material is removed and either "aired" off or washed well with water. The method is a very crude one, and no improvements have been made in the actual process up to the present time, except in the method of burning the sulfur. It gives a good white, having a brilliance or bloom which is much esteemed in the hosiery trade. The bleach, however, is not permanent, and exposure to the air, aided by the action of alkalies, soon develops a dull yellow color on the material. Stoved yarn knitted with colored threads may destroy or alter these colors. Further, when knitted with fine cotton or rayon fibers these may become tendered. Some bleaching has been done by using solutions of bisulfites, sulfites or hydrosulfites, followed by acid, but this is a two-bath method and the results are not so good as stoving while having the same disadvantages. A process has been patented by King and the Wool Industries Research Association for bleaching with a solution of bisulfite brought to a definite pH value, which claims to produce a permanent white. In the hosiery trade the use of sulfur compounds for bleaching is gradually diminishing.

As mentioned above the bleaching by sulfur dioxide (a reducing agent) is not permanent. When, however, material is bleached by oxidizing agents, the color does not return on exposure to air. The oxidizing bleach used for cotton cannot be used for wool or silk because it seriously affects these fibers. The most suitable oxidizing agent for wool and silk is hydrogen peroxide, and this was suggested for bleaching these fibers as far back as the eighties of the last century. Unfortunately it was then too expensive to use, but in the early years of the present century it was produced commercially at a cheaper rate, which enabled it to be used more extensively in the bleaching of hosiery. At the same time the increased demand has materially reduced the price.

The process in principle is simple. Usually a bath of

peroxide of two volume strength, just neutralized or very faintly alkaline, is made and the material steeped in this bath, heated to about 120° F., for several hours or overnight. A slight rinsing afterwards is advisable but not absolutely necessary. It is essential that no metals except lead or tin come into contact with the liquor or material during the operation. Some slight improvements have been made in recent years, although the general principle of the process remains the same. The indicator for neutrality at first used was litmus, but this was found unsatisfactory, and more sensitive indicators are now used giving more accurate pH control. A bath which is too alkaline may result in loss of oxygen without doing effective work in bleaching and thus wasting material. The alkali at first used for neutralizing was ammonia, but silicate of soda is more often used now since it gives a more stable bath and is therefore more economical. Also any iron or copper which may be in the goods is less likely to cause damage. Further progress recently has been the introduction of other chemical substances which still further stabilize the baths.

The advantages of the peroxide bleach are many. It gives a purer and more permanent white than the stoving method. The goods have a soft handle, do not tender and do not give rise to objectionable odors in wear. Although peroxide gives an excellent white it does not produce the peculiar bloom so much desired in the hosiery trade, and consequently the peroxide process is usually followed by a mild sulfur stoving. Some peroxide bleachers are now adopting the method of giving a shorter steep in a much stronger bath, squeezing out the excess of peroxide and piling the goods for several hours to allow the bleaching to complete. This process permits a larger weight of goods to be put through the baths in a given time and is claimed to be more economical.

For the bleaching of cotton hosiery goods the standard method is the old bleaching powder one. It is cheap, gives good results, and if carefully carried out there is little risk of tendering. This is an important point in dealing with knitted goods, especially of the more open type, since a single loop broken lets down a number of others and soon forms a large hole. Hence the necessity of thorough washing after steeping in the bleaching powder solution and also again after the acid bath. Many bleachers now use sodium hypochlorite which really needs no souring-off, though this is frequently done. It is now quite common to find bleachers using indicators to control the pH of the bleaching bath. The same process is used for the rayons or mixtures of these with cotton, but the rayons, being fine fibers, require special care to avoid tendering. Although the hypochlorite bleach is cheap and good there seems to be indications that eventually hydrogen peroxide will replace it, particularly in the case of cotton goods of fine counts where the risk of tendering is serious.

In the case of mixed cotton and wool, cotton and silk or rayons with wool or silk, the hypochlorite method cannot be used, and bleaching is done with peroxide.

DYEING OF HOSIERY

On the dyeing side, progress has been more marked and this may be attributed to various causes. These have been mainly changes in fashions, variations in texture and design, the introduction of new fibers and mixtures of these, and the increasing number of new dyes and auxiliary products provided by color and chemical manufacturers.

Formerly dyed hosiery was mostly black, navy blue or tan. Wool hose were dyed with natural colors—logwood, fustic, etc., and cotton with direct colors, sulfur colors and developed aniline black. Many of the natural colors have been gradually replaced by synthetic dyes, although logwood blacks and navies are still dyed. The only fancy effects were "clocks", afterwards worked into the hose by colored silk or mercerized cotton threads.

The hosiery dyer has several difficulties to contend with which do not obtain in other fabrics made of the same fibers. One of the chief of these is the presence of tight seams and linkings or joinings at the toes. Again there is a strong tendency when the material is wet for the heels and toes to "tuck in." While it is easy to dye the bulk of the garment level, it is difficult to get the tighter parts penetrated, and although a stocking may appear to be dyed level, as soon as it is stretched on the trimming boards, any want of penetration in the seams, etc., at once shows up. With cotton hose a severe and longer boiling helps materially in levelling, but with wool hose another difficulty crops up. Too long and severe boiling will cause the hose to become milled or felted, so that the characteristic stretch of knitted material is lost to a greater or lesser extent. Also in very pale colors long boiling alters the color of the wool fiber itself and results in a flat or dull shade. Owing to these peculiarities of knitted material the hosiery dyer is often limited in his choice of colors and has to select those which are easily levelling and give good penetration. This frequently means a sacrifice to some extent of fastness to washing. As far as men's half-hose are concerned, the newer fibers (mercerized cotton and rayons) are chiefly used for obtaining pattern effects, and wool forms the main portion of the article.

In the case of ladies' hose there has been a gradual replacement of cashmere by fibers capable of being knitted in finer gauges. The manufacture of these became possible on the introduction of rayon, and in cheaper forms use has been made of fine lisle thread. For thicker hose, rayon backed with wool or cotton is used. In recent years pure silk, knitted in the gum, has found increasing use in the production of fine gauge hosiery.

The evolution of these varied forms of hose has made necessary the development of an entirely new technique on the part of the hosiery dyer. Whereas formerly he had to produce given shades of varying degrees of fastness on an article composed of one kind of fiber, he is now required to dye material containing two or more different fibers in solid shades. Often he has to dye one fiber and either leave the other white or dye it another color altogether. In fulfilling these various demands he has re-

ceived considerable assistance from the color manufacturers who are continually introducing improved ranges of colors suitable for the purpose and generally of improved fastness.

Another result of the increased use of lighter weight hosiery has been the need for alteration in the design of dyeing machines. The older type of paddle machine, whether of wood or metal, which could deal satisfactorily with the heavier cashmere or cotton hose is quite unsuitable for the more delicate types. Newer machines have been designed to give a maximum circulation of the liquor with a minimum movement of the goods so as to avoid damage to the delicate material. These machines are practically all made of metal and have enabled the dyer to deal satisfactorily with all forms of modern hosiery.

UNDERWEAR AND OUTERWEAR DYEING

At one time the knitted garments worn next to the body were made of wool or cotton or mixtures of these fibers, either in the natural state or simply bleached but very rarely dyed, and chiefly of heavier texture. Fashion in ladies' dress has led to a change to a much lighter type of underwear, and also to a demand for this dyed in delicate tints—the so-called lingerie shades. Other forms of knitted fabric such as interlock, milanese, etc., chiefly of cotton or rayon, are being extensively used for other articles of underwear, and these also are mostly dyed in various colors. Consequently the hosiery dyer has had to turn his attention to the dyeing of tubular knitted fabric in a similar manner to the dyeing of cloth pieces.

Formerly the only knitted outerwear which concerned the dyer were articles such as jerseys, cardigan jackets, etc., of wool. Of recent years considerable use has been made of tubular fabric for outerwear garments, chiefly for ladies and children. These are mostly of wool with cotton or rayons to produce pattern effects. Here again the dyer must choose easily levelling colors which can be quickly dyed, but with the added necessity of greater fastness to light. Many fast colors which may be employed for woven fabrics cannot be used by the dyer of knitted fabric for the reasons already mentioned.

There has also been considerable increase in the production of knitted wool fabric for bathing costumes and beach wear. This has brought another type of fabric within the scope of the hosiery dyer having other fastness requirements. Here again the retention of the elasticity of the knitted fabric is very essential and the colors used must be fast to light, water, washing and sea-water. Many colors otherwise suitable were found wanting in fastness to sea-water, but in most cases the color manufacturers have succeeded in bringing out modifications to give the required fastness.

FINISHING OF HOSIERY, ETC.

One of the most important processes connected with the finishing of woolen knitted fabrics and hosiery is the unshrinkable finish. This consists of a chlorination treatment in order to reduce the felting properties of wool. This must not be confused with the London-shrunk or fully-shrunk process applied to woven suitings and coatings, or similar process applied to other woven fabrics where the material is shrunk by mechanical means to its limit. In the case of knitted fabrics, shrinking properties must be basically prevented, and it is essential that the elasticity be fully retained even after repeated washings.

This process has gradually developed from a crude beginning, and experience has taught how to control it to a certain extent, but the exact nature of the process is not fully understood. Systematic research is being carried out on this important process by several investigators, notably the Wool Industries Research Association, and concurrently on the chemical composition of the wool fiber and its reactions to various chemical processes.

With regard to the finishing of footwear, the advance in the amount of artificial silk and artificial silk and cotton mixture hosiery has led to the introduction of mechanical finishing machines for this class of goods. The older method of finishing was done by pulling the partly dried hose on to wooden forms and then putting them between the steam heated beds of a screw or lever operated press. In the newer machines the dry hose are put on to metal forms which then pass through a spraying chamber and on to squeezing rollers which distribute the moisture equally over all parts of the hose. They are then passed through a heated chamber to dry them, and finally through hot rollers to impart an outside finish. The whole of the operation is continuous, an operator putting the hose on the forms at one end of the machine and another operator stripping them at the other end of the machine. These machines are very suitable for the fine gauge hosiery now in demand.

On the fabric side, the older type of heavy calenders are still used for cheaper classes. These machines, however, are not suitable for the newer kinds of fabrics. For these, special machines have been devised, amongst which may be mentioned the continuous tentering and drying machine for tubular fabrics, the lighter type of calender and also the new automatic intermittent press. The flat stenter machine is being introduced for finishing locknit and warp fabrics in open widths.

It will be seen from the foregoing remarks that the work of the hosiery dyer and finisher has gradually become much more complex, and this complexity is apparently on the increase. Also more research is being undertaken in almost every branch of the industry, and it is obvious that the dyer and finisher must keep up with the progress being made in this manner. To cope with this need for more accurate control of the various processes in the light of the newer knowledge obtained, many works have fitted up laboratories and employ a technical staff. The technical colleges are also giving more facilities for the training of men so as to fit them for the proper carrying out of the various operations.

Gloss and Glossiness

(A Tentative Outline of Concepts, Definitions, and Terminology)

GLOSS is the power of a surface to reflect light specularly.

Glossiness is the appearance of a surface ascribable to its power to reflect light specularly.

This outline was prepared by Deane B. Judd following a conference between P. H. Walker, E. F. Hickson, K. S. Gibson, D. B. Judd, and R. S. Hunter. It has been agreed to by each.

Apparent Reflectance of a sample is the reflectance which a perfectly diffusing sample must have in order to yield the same brightness under the same conditions of illuminating and viewing. In this discussion we shall deal with unidirectional illumination; for such illumination apparent reflectance is a function of four variables, altitude and azimuth of the illuminating beam, altitude and azimuth of the direction of view.

The gloss of a surface is completely specified only when its quadruple infinity of apparent, unidirectional reflectances is known, and in these terms the gloss of a surface is the degree to which its apparent reflectance varies with angle. Thus it may be seen that there are many ways in which a surface can depart from the perfect gloss of an ideal mirror.

In dealing with actual samples in a practical way it has been found generally sufficient to make one or two of five kinds of determination, which are expressible as functions of apparent reflectance in the plane of the illuminating beam only; this permits us to use the symbol $A_{i,\,r}$ for apparent reflectance where the first subscript indicates the direction of the illuminating beam measured from the normal, and the second subscript similarly indicates the direction of view. The five functions of apparent reflectance, $A_{i,\,r}$ are given together with the names by which they are known and their definitions.

1. *Specular gloss* (G_s) is the ratio of apparent reflectance of the sample illuminated unidirectionally and viewed in the direction of regular reflection to the apparent reflectance of the standard, similarly illuminated and viewed; the standard is either a perfectly reflecting, perfectly polished surface or a perfectly polished specimen of the same material; the angle of illumination is 45° unless otherwise stated.

$$G_s = (A_{\text{sample}} / A_{\text{standard}})_{i,\,-i}$$

This concept has also been called objective gloss or polish.

2. *Contrast gloss* (G_c) is expressed as a fraction whose denominator is the apparent reflectance of the sample illuminated roughly unidirectionally and viewed in the direction of regular reflection, and whose numerator is the same apparent reflectance diminished by the apparent reflectance of the sample similarly illuminated and viewed normally; the angle of illumination is 45° unless otherwise stated.

$$G_c = (A_{i,\,-i} - A_{i,\,o})/A_{i,\,-i}$$

This concept has also been called simply gloss, or, since with a large angular size of source it correlates somewhat more perfectly than regular gloss with glossiness, it has been called subjective gloss.

3. *Distinctness-of-image gloss* (G_I) depends on the rate of change with angle of incidence of apparent reflectance for a direction of view deviating from the direction of regular reflectance by a small angle (perhaps about one minute to one degree). It may also be expressed as a function of the least angular separation δi, of two linear elements in the illuminant still permitting their resolution in the reflected image. Two possible quantitative definitions are:

$G = (dA_{i,\,r}/di)/(k + dA_{i,\,r}/di)$ where $r = -(i + \delta i)$ is a small angle of the order of one minute to one degree, and k is an arbitrary constant which should be adjusted once for all to give a convenient scale.

$$G_I = k/(k + \delta i)$$

This concept has also been called image reproduction.

4. *Absence of bloom gloss* (G_b) is exhibited only by samples for which distinctness-of-image gloss is high, and is defined as the degree of freedom from surface-scattered light near a high light. *Bloom* is the presence of surface-scattered light near a high light and is quantitatively defined as the difference between the apparent reflectance of the sample a few degrees (say 5) off from the direction of regular reflection and the apparent reflectance many degrees (say 45) off from it.

$G_b = k/(k + A_{i,\,-i-\delta i} - A_{i,\,o})$, where G_I is greater than 0.50, i is 45°, δi is 5° unless otherwise stated, and k is an arbitrary constant.

5. *Absence-of-texture gloss* (G_t) is possessed only by surfaces of relatively high gloss and is the degree of freedom of one of the preceding four types of gloss from variation depending on the size of the sample viewed. Texture probably affects judgments of sharpness-of-image gloss more than other types. Thus far texture has been treated by visual judgments of greater or less texture or by pho-

tographs which serve as a record of amount and kind of texture. A possible quantitative definition is:

$G_t = k/(k + dG/da)$, G greater than 0.50 where a is sample area, and as before k is an arbitrary constant which should be adjusted once for all to give a convenient scale.

This concept is also called surface smoothness.

All of the suggested definitions for these five types of gloss when applied to a perfectly diffusing surface yield a value zero except G_b and G_t which do not apply to matt surfaces; and all definitions when applied to the perfect surface of an ideal mirror yield a value of unity. They each may therefore be taken as a direct measure of gloss of one particular type, and names for them have been selected on this basis. Taken together they form a basis for a fairly complete description of the gloss of actual surfaces which exhibit no structural regularities; that is, if a sample may be rotated in its own plane without changing in any of these five respects it has thus far been found that its gloss is specified with sufficient completeness for practical purposes. Other samples (fabrics, brush-marked paint film, machined metal surfaces) require further functions and concepts for a satisfactorily complete specification of gloss.

Specular gloss and contrast gloss may be evaluated by using suitable reflectometers, either visual or photoelectric. Distinctness-of-image gloss, absence-of-bloom gloss, and absence-of-texture gloss have not so far been evaluated in a quantitative way, but it is probable that this may be done in the near future. The quantitative definitions given for G_i, G_b and G_t may possibly prove to be suitable; a decision on this point must await attempts to evaluate them for actual samples.

TRADE NOTES — NEW PRODUCTS

OBITUARY

MAX WALLERSTEIN

DR. MAX WALLERSTEIN, president and founder of Wallerstein Company, Inc., died on Thursday, April 1st, at his home at 33 East 70th St., New York City, after a long illness.

He had specialized in the field of enzymes and their industrial applications to the fermentation industries, food products, textiles and tanning.

He was born in Fuerth, Bavaria, and was educated in Germany, obtaining his Ph.D. degree from the University of Munich in 1896. Coming to America the following year, he founded the Wallerstein Laboratories in 1902. In later years he made many contributions to the technique of brewing.

Surviving are his widow, a son, a daughter, a brother and a sister.

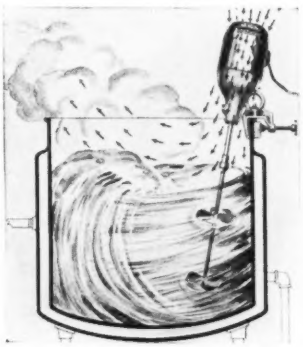
• PAN-AMERICAN COLOR & CHEMICAL CO., INC.

Announcement has been made of the opening of a factory, warehouse, laboratories and offices of the Pan-American Color and Chemical Co., Inc., at 18 Market Street, Paterson, N. J. Complete stocks of acetate, direct and diazo dyes, textile products and chemicals will be kept for prompt service. In addition they will act as headquarters for quinizarin and dinitraniline. William C. Baur is president of the company.

• PORTABLE MIXERS

Portable Mixers, equipped with totally enclosed air-jacketed motors and explosion-proof air-jacketed motors are an exclusive patented development of the Mixing Equipment Company, Rochester, N. Y., and said to be of utmost importance to the process industries. The developments are covered by United States Patents Nos. 2042511 and 18117353.

"Lightnin" portable safety mixers, equipped with totally enclosed air-jacketed motors, can be used over steaming kettles, jacketed tanks, and other receptacles which throw off steam and acid fumes. Emanations from the mix are blown away from the motor and rendered harmless to the motor windings.



Air is drawn into the top of the motor by a fan, and circulated through the entire motor housing by a jacket. A steady stream of cool air is thus afforded, maintaining the proper motor temperature. It is claimed that dirt, grit, and dust are kept entirely out of the windings and bearings.

"Lightnin" portable explosion-resistant mixers, equipped with explosion-resistant motors carry the underwriters label approved for Class 1, Group D applications permitting their use on explosive batches in hazardous locations. These mixers have the same patented features as the other totally enclosed air-jacketed models, and carry in addition the Approved Label of the Underwriters Laboratories.

• WORLD CHEMICAL DEVELOPMENTS

Improvement noted in the French dyestuffs industry during 1935 continued last year with both production and consumption recording 10 per cent gains, according to reports received by the Commerce Department's Chemical Division. The output in 1936 aggregated 11,400 metric tons, estimates indicate, which compares with an estimated production of 10,650 tons during the preceding year.

The British chemical industry did not merit its reputation as the "barometer of British business" in 1936, but as the year closed there were unmistakable signs that the industry was rapidly approaching the high level of production already being enjoyed by most other major manufacturing units.

The year was especially satisfactory for manufacturers of heavy chemicals and dyestuffs. The former profited from the record year enjoyed by iron and steel, engineering and construction, and manufacturing enterprises generally. Noteworthy recovery in the long-stagnant cotton textile industry contributed most of the increase in dyestuffs consumption.

A Chinese chemical enterprise began manufacture of ammonium sulfate recently and made delivery of the first lot in February, advices from Shanghai state.

The Sao Paulo State Government enacted a law on January 4 conceding certain financial favors to concerns undertaking the manufacture of sulfuric acid from domestic pyrites found within the

state. Low grade pyrites are found in many parts of Brazil, reports from Rio de Janeiro state.

A new sulfur refinery which handles 7,000 metric tons of ore monthly and has a daily capacity of 100 tons of sulfur recently began operations in Chile near the Bolivian frontier.

Owing to climatic conditions favorable to the dairy industry, and to better prices for butter fat, production of casein in the Argentine increased substantially last year. Shipments to the United States increased over 150 per cent to a total of 2,609 metric tons during the year, a report from Buenos Aires states.

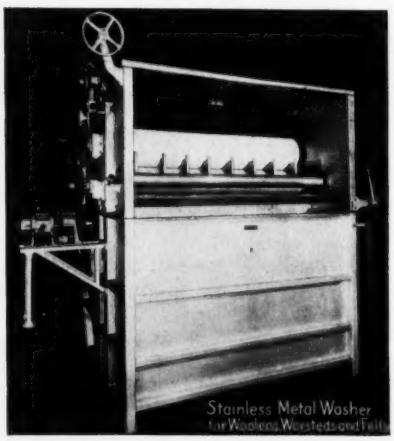
• NOPCO REPRESENTATIVES

Appointment of new sales representatives to territories covering Maryland and Virginia and Maine, New Hampshire and Vermont were announced today by Thomas A. Printon, general sales manager of the National Oil Products Company of Harrison, N. J.

Paul Starke was assigned to Baltimore to cover Maryland and Virginia while H. L. Harden has been sent to cover the Maine, New Hampshire and Vermont territory, Mr. Printon said. Both men have been employed in the National Oil Products Co. laboratories and are graduates of the firm's technical school, he added.

• NEW METAL WASHER

This new machine made by Riggs & Lombard, Inc. of Lowell, Mass, is designed for the washing of woolens, worsteds and felts. It is reported to be the first machine of its kind on the market. It is made entirely of stainless clad steel, all welded, and for this reason is said to reduce up-keep cost to a very nominal figure and to stay clean and stainless. The



main rolls are rubber; the carrier rolls are stainless metal. No wood is used anywhere. It is claimed that the machine is already in successful operation in several well-known woolen mills.

• N. Y. U. COURSES

The Department of Chemistry of Washington Square College, New York University, will offer two intensive three weeks courses in "Colorimetric Analysis" and "Electronics" from May 24th to June 12th, 1937. Both courses may be taken simultaneously if desired. Each will consist of fifteen lectures and fifty hours of laboratory work with optional attendance at conferences.

The Colorimetric Analysis course under the direction of Professor Ralph H. Muller will be devoted to a discussion of fundamental optical principles, the use of various colorimeters, photometers, the spectrophotometer and the spectrograph. Emphasis will be placed upon photoelectric methods. The laboratory work will acquaint the student with the use and operation of these instruments and their application to representative problems.

The Electronics course under the direction of Dr. Raymond L. Garman will deal with the fundamental theory of electron tubes and associated equipment with emphasis on applications to chemical research and industrial control. The laboratory exercises will include graded experiments with vacuum tubes, photocells, cathode ray tubes and thyratrons, and representative physico-chemical measurements utilizing these devices.

In both courses properly qualified students will have the opportunity to develop new applications.

Further information may be obtained by addressing the Administrative Chairman, Department of Chemistry, Washington Square College, New York University, New York, N. Y.

• NEW COLGATE SOAP

Colgate-Palmolive-Peet Company has recently introduced a new blended oil, soda soap to the textile trade, under the brand name Colgate Formula 25. This product, available in bulk, bar and flake form, is rapidly finding favor in many textile mills.

Besides decided savings, users are said to report results duplicating those formerly obtained with types of soaps not now readily obtainable. Production on the new item has been stepped up to meet the increased demands for a soap of this type and quality.

• FERRISUL

The Merrimac Chemical Co., Everett Station, Boston, Mass., has recently issued a booklet on its product "Ferrisul," which describes its use for treating water, sewage and industrial waste. Copies of the booklet are available upon request.

• MOIST-O-GRAPH FOLDER

The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa., has just published a folder entitled: "Here's the Latest Achievement for Slasher Control." It illustrates and describes the principle of operation of the Brown Moist-o-Graph, a new method for slasher control. Ask for folder No. 93-2.

• M.I.T. SUMMER COURSE

A special summer course to be known as "Principles of Textile Analysis" will be given by Professor Schwarz at the Massachusetts Institute of Technology. The course will combine lectures, demonstrations, and laboratory exercises and will cover six weeks beginning in the last week of July and extending through the week of September. Further details may be obtained by addressing the Summer Sessions office at the institute in Cambridge, Mass.

• ELECTED DIRECTOR

At the last director's meeting of the Pittsburgh Plate Glass Company held in New York on March 3rd, E. T. Asplundh,

who has held the position of assistant to vice-president of the Columbia Chemical Division of the Pittsburgh Plate Glass Company, was elected as director to fill the place made vacant by the death of Edward Pitcairn. Mr. Asplundh makes his headquarters at Barberton.

• MADE SALES REPRESENTATIVE

J. Gaynor Mac Intyre of the Technical Sales Staff of the National Oil Products Company of Harrison, N. J., has been appointed New England sales representative of the company to succeed the late Adam Craig, who died last month. Mr. Mac Intyre will specialize on the textile industry.

Thomas A. Printon, general sales manager of National Oil Products Co., in announcing the appointment said:

"In addition to his technical sales experience with the company, Mr. Mac Intyre brings to the technical industry a wealth of knowledge from his many years

of practical experience in textile processes."

Mr. Mac Intyre's experience included supervision of the dyehouse in Lancaster Mills, cotton fabrics; Barre Wool Combing Company, woolen and worsted yarns; Carl Stohn Inc., rayon lastex fibers and Bradford Dyeing Association, rayon and acetate crepes and taffetas.

• L. & N. CATALOG

A 32-page catalog (EN-96) on apparatus for hydrogen-ion concentration (pH) measurements in laboratory and plant has just been issued by Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

The catalog describes and lists the latest forms of L & N electrodes, potentiometers, a potentiometer-electrometer and galvanometers for determining the pH of aqueous solutions for research and analytical purposes in the laboratory and for process control in the plant. For the latter purpose, equipment is described for spot tests, and for continuous recorded measurement, which, in the case of certain specific processes, leads to continuous recorded measurement with automatic control.

Data on applications, advantages, limitations, useful ranges, limits of error, potentials, etc., simplify the selection of electrodes, potentiometers and galvanometers required. As a consequence there should be no difficulty in choosing the most suitable equipment for any proposed application.

• TEXTILE SCHOOL TO BE ENLARGED

During its recent session the legislature of North Carolina appropriated $45,000 to enlarge the Textile School at North Carolina State College, and $15,000 additional money for new equipment.

Present plans are rather indefinite, but it is thought that a part of the new addition will house a complete research laboratory especially constructed, equipped and staffed with physicists to do research work on textile fibers, yarns and fabrics. It is also expected that a unit of woolen machinery and full fashioned knitting will be added to the present equipment.

For more than thirty years Dr. Thomas Nelson has directed textile instruction at State College, and he has seen the textile division grow from a small department until it is now one of the three major divisions of State College. In his opinion the textile industry is an exceptionally fertile field for young men with a textile education. He says that the scientific improvements which are constantly being made in the manufacture, processing and distribution of textile products are creating an increasing demand for technically trained men.

• WALLERSTEIN PATENTS

Notice has been given that most of the pioneering work on the application of Papain and its activators in the degumming of silk was done by the Wallerstein Co. many years ago and has since been granted the following patents: U. S. Patent 1,644,764, October 11, 1927; U. S. Patent 1,763,112, June 10, 1930; U. S. Patent 1,855,431, April 26, 1932; U. S. Patent 1,877,097, September 13, 1932. Wallerstein's enzyme degumming preparations are sold under the trade names of "Seritex" and "Serizyme," respectively.

• GEIGY RELEASE

Geigy Company, Inc., 89 Barclay Street, New York City, announces release of the following shade card:—

Dyestuffs for Union Dyeing—in this edition of Geigy's union shade card there are shown all suitable dyestuffs placed on the market since the last edition. The patterns are displayed in the following sections: I. Union Colors, II. Union Fast Colors, III. Direct Colors which dye wool and cotton in about equal depths, IV. Direct Colors which dye cotton darker than wool, V. Direct Colors which are suitable for the Union-Chrome process, VI. Diazotizing Colors, VII. Wool Colors which draw well from a neutral bath, VIII. Erional L and CL, IX. Irgasalt AP. In addition to the color swatches, dyeing instructions are given for each grouping of dyestuffs. Shade Card No. 892.

• IMPREGNOLE

Warwick Chemical Co., West Warwick, R. I., announces publication recently of a booklet entitled "Impregnole," which describes the use of this product in the textile industry. Included in the contents are discussions regarding the application of Impregnole to wool, cotton, rayon or silk, knitwear, and the processing of garments in dyeing and dry cleaning. There is also contained information regarding the composition and efficacy of Impregnole, explanation of water repellency and methods for the removal of Impregnole. Copies of this booklet are available upon request.

• STABILIZATION OF TEXTILE INDUSTRY

Editorial Research Reports, 1013 Thirteenth Street, N.W., Washington, D. C., announces publication of a report entitled "World Stabilization of the Textile Industry" which discusses the domestic and world regulation of textiles, the condition of the world textile industry and the problems of the domestic textile industry. Copies are available at the above mentioned address at $1.00 per copy.

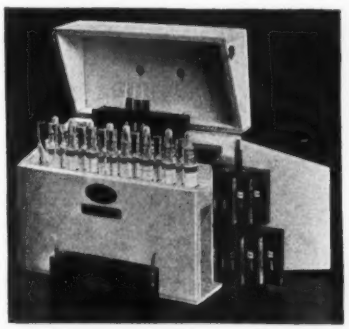
• MEETING, S. C. I.

A meeting of the Society of Chemical Industry, American Section, held jointly with the American Chemical Society, took place April 9th at The Chemists' Club, 52 East 41st Street, New York City. Mr. James G. Vail was the chairman. The guest speaker was Professor James E. Kendall, on an American tour from Edinburgh, Scotland. He spoke on the subject of "Liquids and Solutions."

• NEW pH EQUIPMENT

A new portable pH outfit, the Long Range Slide Comparator, has been developed by W. A. Taylor & Co., Inc., 872 Linden Ave., Baltimore, Md. It is made in seven models (T-3 to T-9) to cover the range of any 3 to 9 indicators respectively, between the limits of pH 0.2 and pH 13.6.

The outfit contains a comparator base,



which fits into a compartment in the front of the case; any 3 to 9 color standard slides, which are contained in two compartments in the back of the case; vials of the corresponding indicator solutions, with 0.5 c.c. pipettes and nipples; and 14-5 c.c. test tubes. The base and slides are molded from Bakelite. Each color standard slide contains 9 color standards covering the range of one indicator, these standards alternating with ampoules of distilled water. For example a phenol red slide contains 9 standards covering the range pH 6.8-8.4 in intervals of 0.2 pH. All equipment necessary for making tests is contained in the case, which has a sturdy handle, so that these sets are ideal for field as well as for laboratory and plant work.

pH determinations are made by filling three of the 5 c.c. test tubes with the sample to be tested, adding 0.5 c.c. of the proper indicator solution to the middle tube by means of the pipette, and placing the three tubes in the holes provided for them in the base. The corresponding color standard slide is then placed in the slot in the base and is moved back and forth until the color of the test sample matches that of one of the standards. The pH value of the sample is then read off from the values on the slide.

OPEN FORUM

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

Answer

40—Can creases in knit goods for underwear be eliminated? The fabric is kier boiled in a vomit kier for twelve hours under twelve pounds pressure, then given a hypochlorite bleach and finished by passing through a mangle.

These creases appear before going through the mangle, and the mangle does not press them out. Information or suggestions will be appreciated.—**W. H. F.**

Answer—We might say that cotton knit goods for underwear, when bleached by the modern peroxide process, do eliminate creases entirely. The bleaching takes place without any pressure on the kier, in fact peroxide liquors tend to open up the goods, thus eliminating creases of a permanent nature. The boiling and bleaching being done on the kier, there is no need for any machinery except a washer beside the kier itself.—B. E. C.

Unanswered Question

41—We would like to know the general principles of the process used in rendering silk transparent. Inasmuch as the process is to be used on rather heavy goods, we believe that one of the newer methods whereby thin layers of fiber have been rendered absolutely transparent is necessary. Information along this line which any of your readers are inclined to give will be highly appreciated.—**Library.**

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

WANTED: a three-color printing machine, 24" rolls, with all accessories, suitable for laboratory use. Must be in good condition and at a reasonable price. Reply Box No. 943, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Chemist capable to take charge or supervise the preparation, dyeing and finishing of rayon, acetates, cross-dyes,—Special experience in crepes—Cotton experience and original research work. Write Box No. 945, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

CHEMIST WANTED: Well known sulfonated oil manufacturer has an opportunity for a chemist possessing necessary experience and knowledge of mineral oils for lubrication and emulsions for textile trade. Write stating age, education, experience and salary expected. Box No. 947, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED—Position open for man with chemical training and practical experience in making Sulfonated Tallows and Soluble Waxes. Write Box No. 949, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED—Mill chemist for dye and finishing plant handling rayon, worsted, and acetate piece goods. State age, experience, education, salary expected. Write Box No. 950, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

Salesman with office and storeroom in Chicago, would represent dyestuff and chemical manufacturer. Long following in middle West. Commission and small part expense. Write Box No. 951, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Print Supt. desires position with reliable company. Thoroughly experienced with all details of machine and screen printing on silk and artificial fibers. Can organize new department. Willing to go anywhere. All replies will be treated strictly confidential. Employed at present. Box No. 952, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.